

SCIENTIFIC AMERICAN

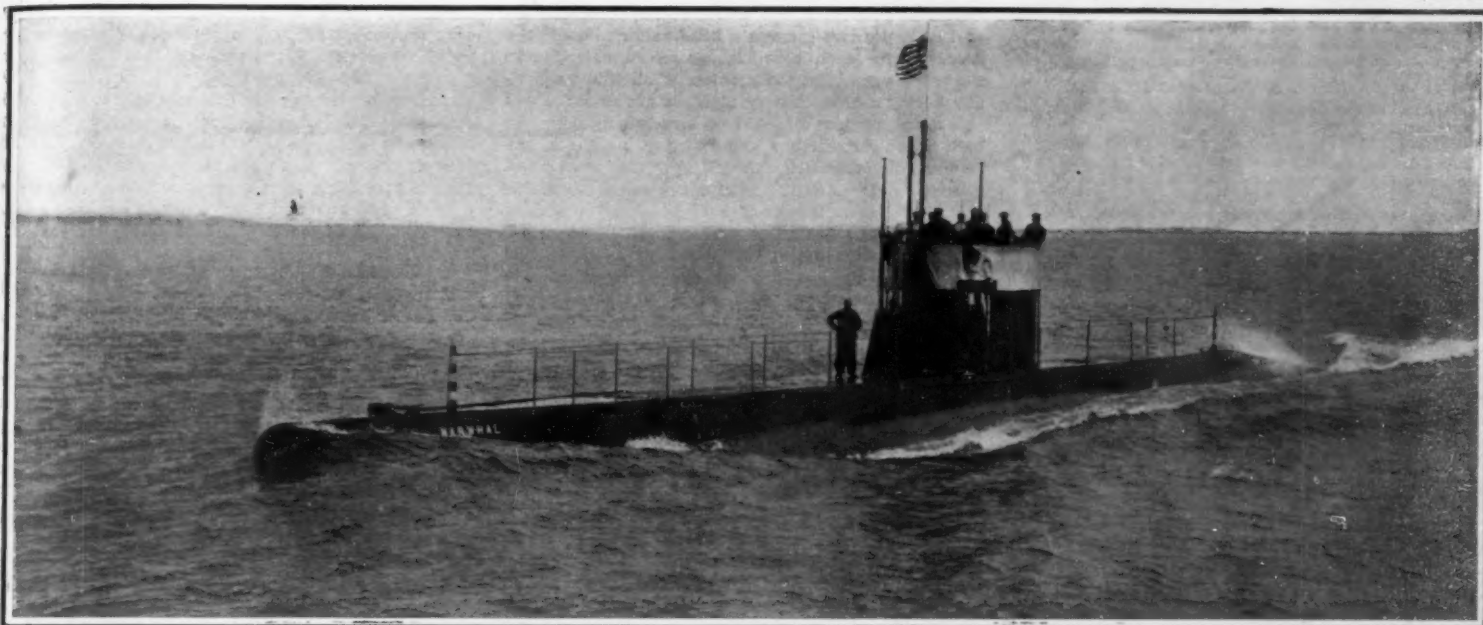
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A POPULAR ILLUSTRATED WEEKLY OF THE WORLD'S PROGRESS

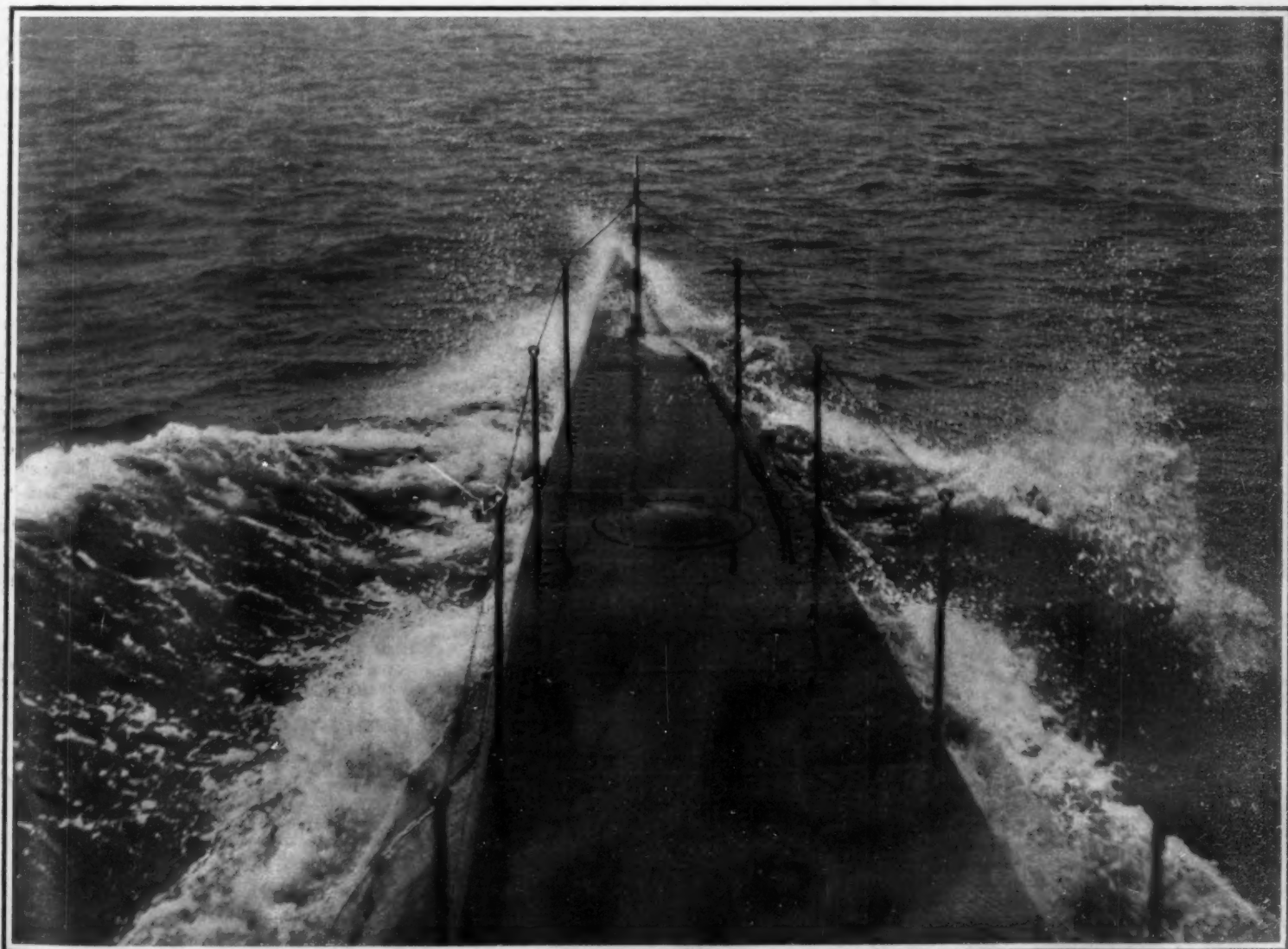
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At the surface the vessel is driven by her internal-combustion engines at a speed of 14 knots.
The "Narwahl" cruising at the surface.



View looking forward from the bridge. Taken when the "Narwahl" was making 14 knots at the surface. Before diving, the stanchions, handrope, removable navigating bridge, steering wheel, etc., are unshipped and passed below.

THE "NARWAHL," LATEST AND LARGEST OF THE UNITED STATES SUBMARINES.—[See page 296.]

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NEW YORK, SATURDAY, OCTOBER 23rd, 1909.

The Editor is always glad to receive for examination illustrated articles on subjects of timely interest. If the photographs are sharp, the articles short, and the facts authentic, the contributions will receive special attention. Accepted articles will be paid for at regular space rates.

A TALK WITH WILBUR WRIGHT.

"No. The next advance in the art of human flight will not be so much in improving the motor as in the practice of high flying. Personally, I am perfectly satisfied with our motor; not that one, but the later type, which has been strengthened in the very part where the cylinder gave way just now." Thus Wilbur Wright. It was in the gathering gloom of an October afternoon, and we were standing alone in the shed which had been built on Governor's Island to house the Wright aeroplane during the late Hudson-Fulton Celebration. A few minutes earlier the machine was on its launching ways, with everything primed for an hour-long flight, in which Wright had purposed to travel up the East River, over the four great bridges that span it, across Manhattan Island, over the Hudson and the Palisades, and return to the starting point, with a wide detour over the Jersey Meadows and across the Upper Bay. We had seen Wright and his mechanic crank the engine by a swift turn of the propellers; had heard the loud explosion and crash, as the forward cylinder tore loose from the crank case; and had seen the wrecked cylinder tear its way through the upper plane and fall at Wright's feet. At the very moment when a million people were lining both shores of the Hudson River, watching with absorbing interest to catch the first glimpse of the author and past master of the art of human flight, lo! here was his machine, rendered an absolute wreck, and the possibility of a Hudson-Fulton flight shut out for good! Under such dramatic conditions of disappointment a Frenchman would have wept. Not so Wilbur Wright. Picking up the broken cylinder, he turned to the small group of which the writer formed one, smiled, gave an almost imperceptible shrug of his shoulders, and quietly remarked, "It is all over, gentlemen."

If there is any appetite for the sensational or melodramatic in Wilbur Wright, he certainly keeps it under masterful control. The fact that he had been opposed to the giving of public exhibitions of flight, and that this was the first and only exception that he had made, would, for most men, have rendered the complete breakdown of his machine a most aggravating disaster. Yet, five minutes later, when we were alone with him and his disabled air craft, he was perfectly composed, and showed his philosophical estimate of the true significance of the mishap by pointing to the broken cylinder and remarking: "This is merely an incident. The machine is an old one that I used at Kitty Hawk. The metal was rather light at the point of fracture. The defect has been remedied in our later motors."

A few months ago we expressed the opinion in these columns that the element which needed most attention in the aeroplane was the motor, and that until the latter had been brought up to the degree of reliability of the automobile motor, the art of flying could not make much material progress. Wilbur Wright, however, does not agree with us. "I have developed my motor to the point at which it has ceased to give me any more anxiety than the motor of an automobile. I have run the later pattern of this motor in an endurance test (not, of course, in the air) for seven consecutive hours, and my machines have made 250 consecutive flights without experiencing motor trouble."

"In what direction, then, will the development of the

future be made?" we asked, and again the answer came back: "High flying; we must get up clear of the belt of disturbed air which results from the irregularities of the earth's surface. From now on you will see a great increase in the average elevation at which aviators will make their flights; for not only will they find in the higher strata more favorable atmospheric conditions, but in case of motor trouble, they will have more time and distance in which to recover control or make a safe glide to earth."

Next we raised the question of suitable starting and stopping places, and suggested that the art of flying was handicapped by the present necessity for broad open spaces for the purpose. This brought the reply that since trains, trolley cars, steamboats, and sailing yachts are all provided with special points of departure and arrival, it was a little unfair to quote the necessity for such conveniences as an objection to the aeroplane. "But the problem of alighting, especially during a cross-country flight, is not so serious as you might suppose. It will be largely solved by the high flying to which I referred just now, for, the greater the elevation, the larger the section of country from which the aviator can select a suitable alighting place. Suppose," said Wright, "in making a flight, say of 100 miles, I rose to a height of one mile, and that while at that elevation motor trouble necessitated an immediate descent. Commencing to glide down the air on a grade of one in seven, I would traverse seven miles of country in a straight line before reaching the ground, that is, supposing that the ground were fairly level. But the glide could be made in any direction, and consequently I could choose a landing place on any one of the 150 square miles that would be included in a circle of 14 miles in diameter. The chances would be therefore decidedly in my favor of finding some fairly smooth field, free from obstruction, on which I could come down safely."

Of course, the question of speed came in for discussion, and the reply to the question whether we shall see any great increase in speed in the near future was characteristic. "Why should we wish to increase the speed? It was only a few years ago that the world believed the construction of a successful flying machine to be impossible, and yet there are not many birds that I cannot overtake with that machine." This was presenting the speed question from a new and very sensible standpoint; for it must be admitted that to have surpassed the average speed of the birds thus early in the game is one of the most sensational achievements of this, the latest and most sensational of man's inventions.

THE NEW BRITISH "DREADNOUGHTS" AND "INFLEXIBLES."

Rather complete particulars have lately been made public of the latest British "Dreadnoughts" and "Inflexibles," which are now being built in government and private dockyards. Taking the "Neptune," as the latest representative of the "Dreadnought" type in the British navy, we find that the length has been increased by 20 feet and the beam by 4 feet, and that the displacement has been increased from 17,900 tons to 20,000 tons. The speed, 21 knots, remains the same, and no changes of any consequence have been made in the disposition of the armor for the protection of the hull or the barbettes and turrets.

The most important changes—those which serve greatly to increase the power of this ship as compared with the original "Dreadnought"—relate to the armament. In the "Dreadnought," it will be remembered, ten 12-inch guns were mounted in the following positions: Two on the fore-castle deck; a pair on each beam amidships on the main deck, with the superstructure between them; and four in two turrets on the main deck astern and on the center line of the ship. This plan has been changed in the "Neptune" by placing the two wing turrets *en echelon*, or diagonally, with sufficient distance between them in the fore and aft direction to permit the guns of both turrets to fire on the same broadside. Another change is to raise these two turrets and also turret number 4, one deck higher, placing them at the same elevation as the forward turret. The aftermost turret will be located, as in the "Dreadnought," on the main deck. By this redistribution the "Neptune" can fire six guns ahead, eight astern, and ten on each broadside, as against six ahead and astern, and eight on each broadside, in the original "Dreadnought." The "Neptune" will carry a new 50-caliber, wire-wound 12-inch gun, and not, as reported, a 13.5-inch gun. For torpedo attack a battery of 4.7-inch guns will be mounted in a lofty central armored redoubt surrounding the smokestacks, which will protect both the guns and the smokestack bases.

The improved "Inflexible," known as the "Indefatigable," has 25 feet more length, 2 feet more beam, and 2,000 tons additional displacement than Admiral Seymour's flagship. The speed is the same; but the extra 20 feet of length will enable the midship turrets to be placed farther apart in the fore and aft direction than they are in the "Inflexible," with the

result that the broadside angle of fire of what might be called the "off turret," that is to say, the turret which is on the side of the ship remote from that on which an engagement is taking place, will be greatly increased.

Great Britain evidently is well pleased with her 26-knot battleship cruisers of the "Inflexible" type, for she is now preparing to lay down on the ways vacated by the "Indefatigable" another ship of the same type but of far greater dimensions. She is to be 600 feet in length, and equipped with turbine machinery of even greater horse-power than that installed in the "Lusitania" and "Mauretania." As these liners exert over 70,000 horse-power when they are making their maximum speed of 26 knots, it can be understood that to secure the 28 knots required in the new cruiser-battleship, the horse-power must run up to 80,000 or more. It is probable that the vessel, on her trials, like her predecessors of the "Inflexible" class, will exceed the requirements by about a couple of knots. The "Inflexible" and her sisters made 28 knots over short distances, and it is likely that the 600-foot ship will be able to carry her battery of eight 12-inch guns for a short spurt across the high seas at a speed of 30 knots an hour, which is higher than the average speed of the torpedo-boat destroyers.

SOME PHOTOCHEMICAL REACTIONS.

A quantity of benzaldehyde, inclosed in a sealed glass tube and exposed to light, is almost entirely converted into a red brown, transparent resin which, when treated with ether, leaves a small quantity of a crystalline residue, fusing at 475 deg. F. and identical with the trimeric modification into which benzaldehyde is converted by the action of iodobenzol.

The resin deposited by the evaporation of the ether from the ethereal solution yields, on distillation, benzoic acid, hydrobenzoin, and unaltered benzaldehyde, and leaves a resinous residue which has the percentage composition, but four times the molecular weight of benzaldehyde, of which it is probably a tetrameric form. It may, however, be a ketone, of the formula $(C_6H_5)_4(CO)_2(COH)_2$.

Dibenzyliden acetone in alcoholic emulsion exposed to light for a year yields di-isosafrol in addition to the molecular weight of the ketone.

Isosafrol mixed with a trace of iodine and exposed to light for a year yields di-isosafrol in addition to a large proportion of resin, but safrol is unaffected by light. Analogous results are obtained with methyl-eugenol and isomethyleugenol. Propenyl compounds are found to be more affected by light and more readily converted into polymeric forms than members of the allyl group. The action of light on mixtures of benzaldehyde with safrol and isosafrol produces resinous substances which, when purified and analyzed, prove to be simple addition products.

THE SPECTRUM OF MARS.

A bulletin has recently been issued by the Lowell Observatory, in which the results of Mr. Frank W. Very's quantitative measurements of the intensification of great B in the spectrum of Mars are given. The general result of the investigation is that the great B in Mars is 15 per cent stronger than in the spectrum of the moon at the same altitude, and that B in the spectrum of Mars is relatively more intense by eight times the probable error of the result. Mr. Very states that while there is considerable variation, there are no contradictory results. In Mr. Very's opinion, the measurement proves, beyond a doubt, that it is possible to discriminate differences of a few per cent in the intensities of spectral lines, although it would take much wider variations to attract the attention of a casual or even of a careful observer, if deprived of such assistance as can be given by the spectral band comparator. In his recent Mount Whitney studies, Prof. W. W. Campbell, of the Lick Observatory, stated that the A band was faint in both the lunar and solar spectra when the bodies were low, fainter when the bodies were higher, and very faint when the bodies were at their highest; but for equal altitudes, the A band in the Martian and lunar spectra were equally intense, plainly signifying that the observed bands were due to water vapor in the earth's atmosphere above the summit of Mount Whitney. Here is obviously a conflict which must be settled before we know definitely whether or not the spectrum of Mars does contain water vapor.

In the Revue de la Soudure Autogène, Bournonville describes a method of repairing cracked iron pulleys by local heating. The crack in the rim is opened by means of an expansion screw acting on the two adjoining spokes, so as to make a gap about 1/16 inch to 1/24 inch in width. Welding metal being then melted in the crack by means of the oxy-acetylene flame, the expansion screw is withdrawn quickly, while the metal is still red hot, and the elastic pressure of the rim counteracts the contraction of the joint in cooling. No special care is needed in cooling, and the metal can be tempered without risk of cracking.

AERONAUTICS.

Santos Dumont has been making excellent cross-country flights near Paris of late with a new monoplane, fitted with a 30-horse-power double-opposed-cylinder motor. The machine complete weighs only 242 pounds. The Clement company is building a number of these machines, to sell for about \$1,250 each.

The second Aeronautic Show to be held in Paris opened in the Grand Palais on September 25th and lasted three weeks. This exhibition demonstrated how the aeronautic industry has advanced by leaps and bounds within the year. Some thirty different aeroplanes and a score of aeronautic motors were shown, as well as one small dirigible and several plain balloons. A complete description of the show will be given in next week's SCIENTIFIC AMERICAN SUPPLEMENT.

Before starting to teach Lieutenants Lahm and Humphries the operation of the recently acquired government biplane, Wilbur Wright tried the machine out on October 9th and had his pupils time him for a distance of a kilometer in a closed circuit. This distance, including the turn, was covered in 48 3/5 seconds, or at a speed of exactly 46 miles an hour. Allowing 100 meters extra for the turn, the speed was 50 miles an hour. Thus it seems that the new government aeroplane is quite as fast as the Bleriot or Curtiss machines, which made over 47 miles an hour at Rheims.

With the great aviation meet at Rheims as model, almost all the other large cities on the Continent have arranged for a similar event. After Brescia (Italy) and Berlin, Spa, Boulogne, and Dieppe in France; Frankfurt in Germany; and Blackpool in England have put up large cash prizes to secure Latham, Bleriot, Farman, and some of the less well-known but fully as daring aviators. The Frankfurt authorities even went so far as to pay the traveling and hotel expenses of the "bird men." A big meet was held at the new Juvisy aerodrome near Paris from the 7th to the 21st of this month, no less than 37 machines being entered, of which 13 were Voisin biplanes. On October 10th thousands of people flocked to Juvisy. The train service was inadequate, and there was such a demonstration by the crowd that the troops had to be called out.

On October 13th a course of lectures upon aviation to be given by Wilbur R. Kimball was inaugurated at the rooms of the Young Men's Christian Association, 318 West 47th Street, New York city. Besides Mr. Kimball's lecture, which was illustrated with a number of models, Mr. Hudson Maxim, the inventor of maxillite and an authority upon explosives, spoke upon the dropping of explosives from aeroplanes. He thought the public should be rid of the fallacy that much harm can be done in this way. The aeroplane, he believes, will be used for scouting and raiding, but not as an instrument of destruction in itself. Mr. Winthrop E. Scarritt, an ex-president of the Automobile Club of America, gave an interesting talk on the future of aeroplanes.

In connection with the Centennial Celebration at St. Louis, Glenn Curtiss made a number of short but good exhibition flights. There was also a balloon race on the 11th instant, in which 10 balloons competed. The "St. Louis III," piloted by Louis von Phul, won, covering 545 miles in 4 1/4 hours duration, and landing at Lawrence, Minn. The "Indiana," with H. H. McGill pilot and J. M. Schauer aide, landed near Albany, Minn., 500 miles distant. Mr. McGill was taken violently ill, and his aide was finally obliged to bring the balloon to earth to get medical assistance. The "Centennial," H. R. Honeywell pilot, made a flight of 480 miles and landed at Silas, Ala. The "Cleveland," J. Wade, Jr., pilot and A. H. Morgan aide, covered 459 miles and landed near Alexander City, Ala. Baldwin, Knabenshue, and Beachy also made flights at the celebration in their dirigibles. Messrs. Post and Harmon, in the "New York," won the endurance race in 48 hours 26 minutes.

The third international balloon race for the Bennett trophy started from Schlieren (near Zurich), Switzerland, on Sunday, October 3rd. There were 17 starters representing 9 nations and divided as follows: America 1, Austria 1, Belgium 2, England 1, France 3, Germany 3, Italy 2, Spain 1, Switzerland 3. For the second time in four years the cup was won by an American, Mr. E. W. Mix, of Columbus, Ohio—our sole representative—having the good fortune to travel over 648 miles in 35 hours, and, after passing through a drenching rain and having some exciting experiences in the Bavarian Alps, to finally land in the trees in the forest of Gutova, some miles north of Warsaw in Russian Poland. Mr. Mix and his aide were obliged to throw out their life preservers and provisions in order to keep afloat so long. After doing this at Breslau early Monday afternoon, they rose to a height of 9,000 feet, from which elevation they gradually fell until the balloon landed at 3 A. M. October 5th. Second place went to Alfred Leblanc with a record of 631 miles.

ELECTRICITY.

The New York Public Service Commission reports that 3,327 persons were injured last August on the surface traction lines of New York city. This is 12 less than the record for August, 1908. The serious injuries for this August were 204, or 32 less than for the corresponding month of last year.

The Canadian Pacific Railroad has found the telephone so serviceable for train dispatching that the present system of about 500 miles of telephone lines will be extended to 1,000 miles within a year. The company states that about fifty per cent more traffic can be handled now than was possible under the old telegraph system of dispatching.

Every once in a while we hear of wireless telegraphic communication over an enormous range. Recently the army transport "Buford," while nearing Honolulu, succeeded in exchanging messages with the Pacific coast. The distance covered was 3,500 miles. This does not mean that there has been a wonderful advance in wireless telegraphy, but merely that atmospheric conditions were unusually favorable.

The electrification of the street railway line from Woolwich Arsenal to the London County Council free ferry has been brought to a halt owing to possible disturbance of the delicate instruments at Greenwich Observatory. The Astronomer Royal has the power to stop any undertaking within three miles of the observatory that is liable to affect the instruments, and the railroad company must obtain his consent before proceeding with the electrification.

Manufacturers of electrical apparatus have recently awakened to the fact that there is quite a demand for a transformer which will permit of operating electric bells, buzzers, toys, etc., with current taken from line circuits in place of storage or primary batteries. Small direct-current battery apparatus may ordinarily be operated on an alternating current without any change in the windings or connections, provided the voltage is sufficiently reduced. A transformer of this type has recently been put on the market, which will reduce from 110 volts to from 3 to 26 volts.

A very ingenious method of overcoming the friction of intermeshing gears has recently been devised. The gear teeth are electromagnetically held in engagement, without actually contacting. The teeth of the driving gear are magnetized by means of suitable coils, while the teeth of the driven gear serve in pairs as armatures for the magnetized teeth. Of course such an arrangement would hardly be suitable for slow, heavy work, because the cost of current would be greater than that of lubricating oil and the loss due to friction, but for light, high-speed work the electromagnetic engagement would undoubtedly prove very advantageous.

Portable telephone instruments are being made by the Western Electric Company for use on interurban electric railways. The telephone instruments are carried on the cars, and stations are located at various points along the line. The conductor or motorman can connect the instruments to the station by merely inserting a pair of line plugs, and thus can get into direct communication at once with the dispatcher. In case of delay on the road, or an accident, these instruments are invaluable, as they enable the dispatcher to learn the particulars at first hand, and make arrangements to relieve the situation.

An apparatus for sterilizing water has recently been put on the market in France, in which ozone is used to destroy the bacteria. The ozone is generated by means of electric discharges, and the gas is introduced into the water by means of an aspirator. The ozone is led into a mixing tube screwed to the water faucet, and the water is forced by a small pump through several compartments, so that it is divided into a number of fine jets. In this way an intimate mixture of the gas and water is obtained. The device is so arranged that the ozone is generated only when the faucet is opened.

A large electric freight locomotive is being built for the New York, New Haven & Hartford Railroad, with which it will be possible to test thoroughly the advantages of handling freight trains electrically. The locomotive will also be used for hauling heavy passenger trains. Following the present tendency, the motors are placed above the axles, thus raising the center of gravity and reducing the shocks and strains to which the roadbed and track are subjected by locomotives in which the motors are mounted on the axles. The locomotive is mounted on two trucks, one of which is pivoted on a center pin, while the other has a fore-and-aft movement as well as a pivotal movement, permitting it to negotiate curves. Four 350-horse-power single-phase motors are used, which may be operated either with 11,000-volt alternating current or 600-volt direct current. A flexible connection between the power and the wheels is accomplished by gearing the motor to a quill on the axle, which is provided with driving arms that project between the spokes of the wheels. These arms are connected with coil springs, which serve to absorb shocks and strains of transmission and equalize the torque on the gears.

SCIENCE.

The Cook-Pearry controversy will probably be settled by a commission of inquiry appointed by Dr. Ira Remsen. The commission will examine and report on the Arctic records, observations, and data collected by both explorers.

Boomerangs are now made of celluloid and hard rubber. Celluloid is better than cardboard because it is waterproof, light, very hard to break, and can be worked into the peculiar curve and twist so necessary to give the boomerang its peculiar properties.

The owners of a St. Abbs fishing boat have made the important discovery that a net dyed as nearly as possible the hue of the sea, instead of the traditional brown, yields much larger results in the matter of fish caught. The discovery was, says the Western Morning News, put to the test a short time ago, when, out of a fleet of sixty-five boats, the boat with its nets dyed blue made far and away the largest catch. The dye used is bluestone. The discovery has aroused much interest among the fishermen.

Peat, as it comes from the bog, contains from 85 to 95 per cent of water. According to Dr. Ekenberg, it appears that the peat contains a hydrocellulose which is of the nature of a jelly. If the peat is subjected to pressure the hydrocellulose passes through very much as soft soap might, and without separating the water from the peat. If, however, the peat is heated to about 320 deg. F., this jelly is immediately destroyed, and most of the water can be separated by a pressure of about 240 pounds per square inch.

The steamer "Conqueror" at Leith has been chartered by Dr. W. S. Bruce, Edinburgh, the leader of the recent Scottish National Antarctic Expedition, for the purpose of undertaking another expedition to the polar regions. The expedition, it is expected, will be ready to sail in a little more than a fortnight. The present intention is that the expedition will be away for two or three months. Important observations in the neighborhood of Spitzbergen are premeditated, Dr. Bruce being a recognized authority on that region.

A process has recently been patented by two Italian gentlemen for rendering calcium cyanamide inoffensive. At present this product has several serious drawbacks owing principally to its causticity, and the ammonia and hydrocyanic ethers which it gives off. The process in question proposes to add sulphuric acid, diluted with its weight in water, to the cyanamide; after introducing the cyanamide in small quantities to the liquid, the whole should remain slightly acid. After an intimate mixture, the product is dried at 40 to 50 deg. C., and then pulverized.

The following experiment, writes Mr. C. S. Jackson, in Nature, is easily tried, and throws some light on a certain type of illusions. A small cogwheel from an old American clock is the only apparatus required. Holding the axle in the finger and thumb of the right hand, give it a twirling motion, say, counter-clockwise. Let the teeth of the wheel click gently against a small card, or the finger-nail of the left hand. On looking at the wheel the spokes appear to revolve counter-clockwise (as they do) and the teeth to revolve in the reverse direction.

Radium appears to have a marked action on the development of the eggs of the *Philine aperta*. M. Jan Tur, of Paris, made a series of over forty experiments with a very strong radio-active preparation, about 9 milligrammes of radium bromide acting through a thin glass plate upon the eggs in different stages. In the first stages of development, the eggs do not seem to suffer from the effect of the radium, but after a certain period it is found that the organs will no longer be formed. A longer exposure causes the larvae to shrink up and they become only one-fifth of their normal size. After 6 to 9 days there remains nothing but a shapeless mass of cells and the mass is observed to have a rapid rotary movement inside the shell of the egg. The larvae are found to die in 9 or 10 days after the laying of the eggs, without being able to leave the shell.

The occurrence of ores of tungsten in Canada is the subject of a report by Dr. T. L. Walker, recently issued by the Canadian Department of Mines. After pointing out that the metal is used not only in the manufacture of metallic filament electric lamps, but also in the production of tungsten steel and of the tungstates which are employed as a mordant in dyeing, in giving weight to silk goods, and in rendering cotton goods fireproof, he goes on to give particulars of the chief tungsten ores, their geological occurrence, and the methods used in treating them, as well as some statistics of the world's production of them, which has been advancing rapidly of late years. He then gives a detailed account of the occurrence of such ores in Canada, and finally remarks that, though no tungsten production has yet been credited to the Dominion, and that she has no well-developed and established tungsten ore mines, still there are many districts where such ores occur.

THE FIRST GERMAN MONOPLANE TO MAKE SUCCESSFUL FLIGHTS.

Our illustrations show the monoplane of Herr Grade, who is the first German to make successful flights in a heavier-than-air machine. This monoplane resembles that of Santos-Dumont in its general make-up, the aviator being placed below the plane, and the motor—a 4-cylinder air-cooled engine of the V type—being located at the front edge, and carrying a propeller on its crank-shaft. The wings of the monoplane are set at a slight dihedral angle, and are provided with a flexible edge at the rear. A tail with vertical and horizontal surfaces is mounted upon a bamboo pole extending out behind.

While making an attempt to win the Lanz prize of \$10,000 at the Mars aerodrome near Berlin, Herr Grade experienced a bad fall, fortunately without injury. The flight required was one of 2½ kilometers (1.55-mile) in the shape of a figure eight. The aviator made a splendid start, but in the middle of his flight, when at a height of nearly 100 feet, the propeller broke, and the machine came forcibly to the ground. Fortunately, the shock of striking the ground was lessened by the alighting of the monoplane in some low pine trees. The machine was badly damaged, but Herr Grade expected to repair it in a few days.

THE AVIATION MEET AT BERLIN AND LATHAM'S FLIGHT ACROSS THE CITY.

The aviation meeting which was held recently at Berlin was specially noteworthy for the great feat of Hubert Latham in flying across the city of Berlin from the Tempelhofer field to the aerodrome at Johannisthal. This flight was made on September 27th, the second day of the meeting, and it has already been mentioned in these columns. Our photograph shows the machine as it flew across the sheds which were erected for the aeroplanes at Johannisthal. The great height at which Latham flew is indicated by the small size of the monoplane, which looks like a huge bird of prey winging its way in the upper air. Latham made the flight of 6¼ miles across the city in less than 10 minutes. He first made two circuits of the Tempelhofer field, and then started straight off across the city at a height of about 300 feet. As soon as word was received by the waiting spectators at Johannisthal that Latham had started, they all strained their eyes in an effort to see the machine in the distance. Soon it appeared, a mere speck in the sky. It came rapidly nearer, and finally passed overhead, as shown in our illustration. Before coming to earth, Latham completed two circuits of the aerodrome, a distance of about 12½ miles. Upon alighting, he received a decided ovation. The total length of his flight was about 24 minutes.

The opening day of the meeting, Sunday, September 26th, was not very auspicious. Baron De Caters made several circuits of the 2½-kilometer (1.55 mile) course, and Bleriot did likewise. Neither aviator kept aloft long enough, however, to qualify for the speed prize. Leblanc started on his Bleriot monoplane, but only succeeded in making a half round of the course.

On September 27th very little was accomplished, but the following day several excellent attempts were made to win prizes, the best of these being that of Rougier, who flew 44.75 kilometers (27.78 miles) in 52 minutes. Latham and Farman both attempted to win the speed prize. The former covered the required distance of 20 kilometers (12.42 miles) in 18 minutes 43/5 seconds, and the latter in 20 minutes 9 2/5 seconds. M. Bleriot did not quite succeed in completing the 20 kilometers. Rougier, in his long flight, attempted to win the height prize presented by Count Zeppelin, but he

only reached a height of 100 meters (328 feet). Edwards, who was operating a Voisin biplane, had a bad tumble after completing three circuits of the course. He fortunately escaped with only a few slight cuts. Baron De Caters damaged his biplane in making a sudden landing.

On September 29th, Rougier made 31 rounds of the course, and covered an official distance of 77½ kilometers (48.12 miles) in 1 hour and 37 minutes, a speed of 28.73 miles an hour. Latham covered 67½ kilometers (41.91 miles) in 1 hour and 14 minutes.

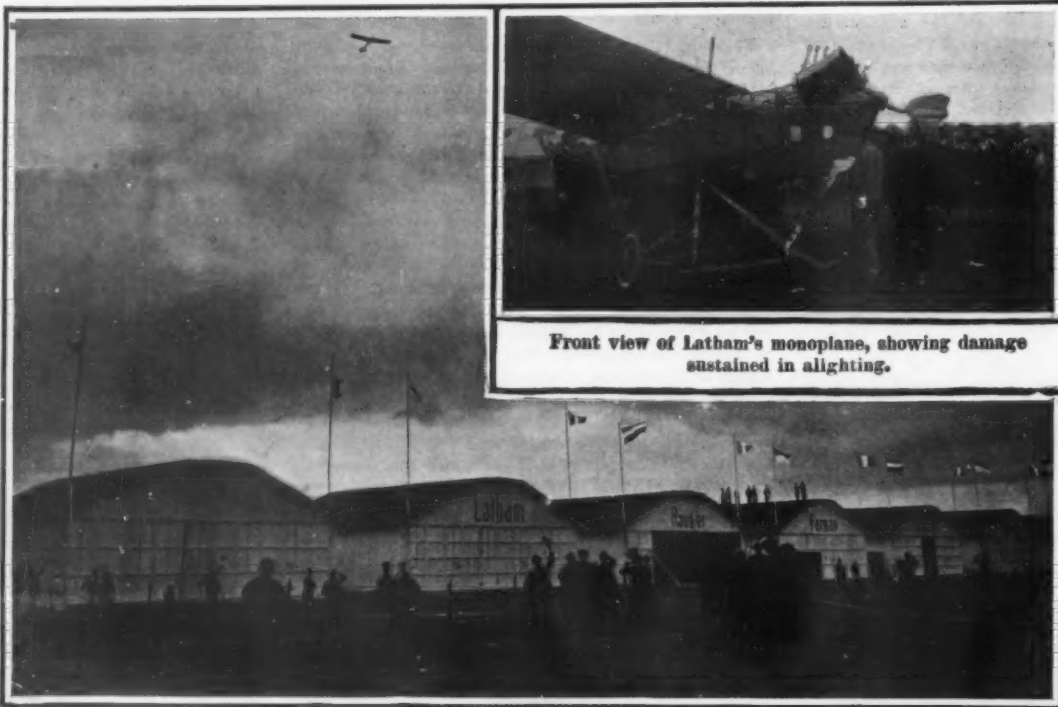


This is the first German aeroplane to make satisfactory short flights.

THE GRADE MONOPLANE IN FLIGHT

His average of 41.22 miles an hour in the 20-kilometer speed test caused him to be declared the winner of the speed prize of \$2,000. On October 1st Rougier won the distance prize of \$10,000 for 2-hour 41-minute 50-second flight, in which he covered 80¼ miles at an average speed of 30 miles an hour.

M. Bleriot's monoplane was attached by the management when the champion aviator attempted to leave with it for Cologne. He had been paid \$5,000 to fly at Berlin on five days, and because he refused to stay, his machine was retained. M. Leblanc also stopped when Bleriot quit. On the whole, this meeting was fairly successful, especially in view of the fact that it was run during the time of the aeronautic show at



The arrival of Hubert Latham at Johannisthal after his flight across Berlin.

In this instance for the first time an aviator arrived at an aviation meeting on his machine, after taking a direct air line.

THE AVIATION MEET AT BERLIN AND LATHAM'S FLIGHT ACROSS THE CITY.

Paris, which opened on September 25th. Latham struck the ground forcibly in one of his landings, breaking a wheel and damaging his propeller as shown in one of our photographs.

Holland compound is a solution of 5 parts of soda water glass and 1 part of carbonate of soda, or a powder mixture consisting of 3 parts of calcined soda and 1 part of dry potash water glass. Ten parts of this mixture is said to be sufficient to render 100,000 parts of hard water soft.

Suicide of Scorpions.

The venoms of serpents, fishes, scorpions, centipedes, spiders, bees, etc., as well as the blood of the eel, owe their virulence to the presence of toxins similar to those which are secreted by bacteria. In both cases the toxins are specific products of the activity of living cells. They are very poisonous, non-crystallizable colloids, of unknown chemical constitution. The venom toxins are very sensitive to the action of heat and light, are easily destroyed by digestive ferments, and consequently are innocuous when swallowed.

There is a great variety of these toxins. Snake poison alone contains half a dozen distinct toxins, each of which exerts a specific action on the nervous system, the red or the white blood corpuscles, etc.

It is possible to produce in any animal an artificial condition of immunity to the effects of any animal venom. This is accomplished by the repeated injection of the venom in doses, each of which is too small to cause death. After a larger or smaller number of injections the animal acquires the power to resist the action of many times the quantity of venom that would suffice to cause death, if it were injected into the veins of a non-immunized animal. The blood of the immunized animal now contains a new substance, an antitoxin which has the property of neutralizing the toxin of the venom, and this blood (or rather its watery part, or serum) may be employed to combat the toxic action of the venom in a non-immunized animal.

The ichneumon, the hedgehog, and some other animals which devour venomous serpents, exhibit an extraordinary resistance to the effect of their bites. This natural immunity is explained by the presence of antitoxins in the blood of these animals. Serpents are also little affected by their own venom. In general, it is almost impossible to kill a venomous animal by inoculating it with the venom of its own species, of which it can support very large doses with impunity.

These facts demonstrate the absurdity of the stories of rattlesnakes and scorpions committing suicide by means of their own venom. It is asserted that a scorpion or a rattlesnake imprisoned in a circle of red-hot coals will sting or bite itself to death. This is a physiological impossibility.—Cosmos.

Common iron scrap has now so low a commercial value that it is hardly worth the trouble of selling, unless it has accumulated in large quantities. But there is a difference in scrap, as the following story proves. A French ship recently sailed from Oakland, Cal., for Genoa, with a cargo of iron scrap collected from the ruins of San Francisco, after the earthquake and conflagration of 1906. The scrap is consigned to the Italian government and is to be used in the construction of a warship of the "Dreadnought" type. It appears that a small lot of similar material, which was brought to Genoa two years ago and mixed with steel, produced armor plates of unusual strength. In consequence of this result, which was due to the intense heating which the scrap had experienced in the conflagration, the Italian naval engineers advised the government to purchase all the scrap iron from the San Francisco fire that could be obtained.

The United States Treasury Department will soon take up the subject of providing sanitary paper money. Not the least of the reforms proposed is the proposition to wash national bank notes. It is said that the idea of washing bank notes is by no means infeasible, for it is possible by means of a chemical solution or bath to clean the notes without injuring the printing.

A SIMPLIFIED METHOD OF TEACHING EXPERIMENTAL PHYSICS.

BY JACQUES BOYER.

Until recently, experimental physics has been taught by rather superannuated methods in the *lycées* and colleges of France. The teachers lacked simple apparatus suitable for the initiation of their pupils into the mysteries of acoustics, optics, electricity and magnetism; although some of the schools possessed magnificent instruments, copies of those of half a century ago, which, in the language of M. Chassagny, the inventor of the apparatus described below, "were a joy to their makers" but of little use to their possessors. There were costly Hiero's fountains and Morin's machines which were used only once a year. The pumps and hydraulic presses were equally expensive and they gave the pupils a totally false conception of the pumps and hydraulic presses employed for practical purposes. Babinet's improved pneumatic apparatus is a remarkable chiefly for its great display of polished copper. The Gay-Lussac eudiometers, Ramsden electric machines, condensers of Aepinus, Watts's machines and many others have now only historical interest. For several years French teachers of physics have been trying to modernize their cabinets of apparatus and to modify their instruments in order to simplify experimental observations. Prominent among these progressive teachers is M. Chassagny, inspector of the Academy of Paris, who has invented a number of efficient instruments of neat and substantial, though inexpensive, construction, with each of which various instructive experiments can be performed.

The complicated machines of Atwood and Morin for the study of the laws of falling bodies are replaced by the mechanical recorder (Fig. 1), which is useful also

in explaining the laws of the compound pendulum and the graphical method of recording movements in general. A bicycle wheel is mounted with its axle horizontal in a flat wooden frame. The rim of the wheel carries a wide band of sheet brass, forming a sort of drum, which can be covered with a band of smoked paper, and one end of the axle bears a small grooved

performed, illustrating the static equilibrium of moments, inertia, the action of constant forces, the law of velocities, proportionality of force to acceleration, resistance of the air, friction, isochronism of small oscillations, the graphic method of registering movements, etc.

In demonstrating the principle of inertia the needle

is brought into contact with the band of smoked paper carried by the drum, and the drum is turned. The pendulum being in the position of equilibrium, the needle traces a line which, when the paper is removed and laid flat, will be straight and will constitute a base line. This line having been traced, the pendulum is drawn to one side, a rotary impulse is given to the drum with the hand, the pendulum is released by moving the lever which holds it, and the needle traces an undulating line. The distances between consecutive intersections of this line with the base line represent equal intervals of time, corresponding to equal vibrations of the isochronous pendulum, and as these distances are also found to be sensibly equal in length, the experiment proves that the drum, set in motion by a momentary impulse, continues to rotate with

practically uniform velocity (the effect of friction being negligible).

In studying the action of a constant force, the base line is traced as before. A cord is then wound round the drum and a weight of about one-quarter pound is attached to its free end, as shown in Fig. 1. The zero point is marked by allowing the pendulum with its needle to swing across the base line while the drum is held at rest. The pendulum is then drawn aside and, by a proper adjustment and manipulation of the lever, the pendulum and the drum are released simul-

(Continued on page 304.)

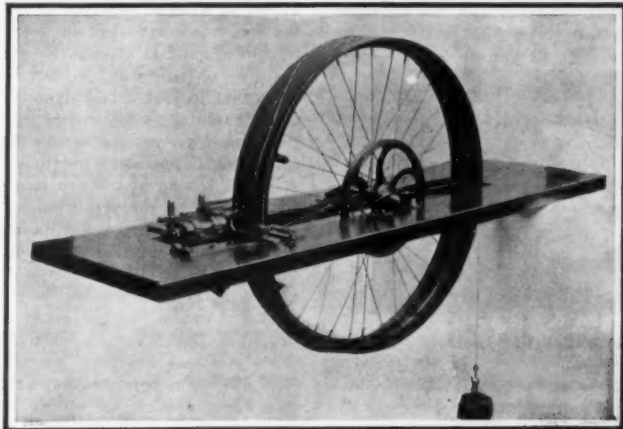


Fig. 1.—The mechanical recorder.

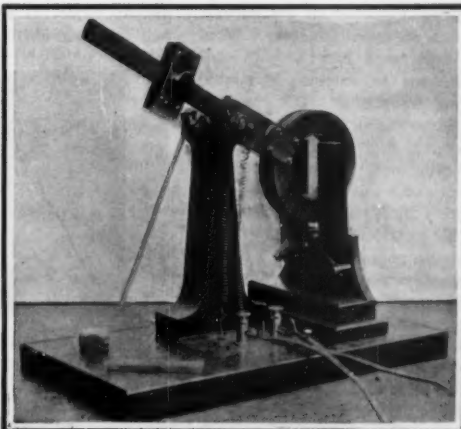


Fig. 6.—Chassagny's apparatus for electromagnetic induction.

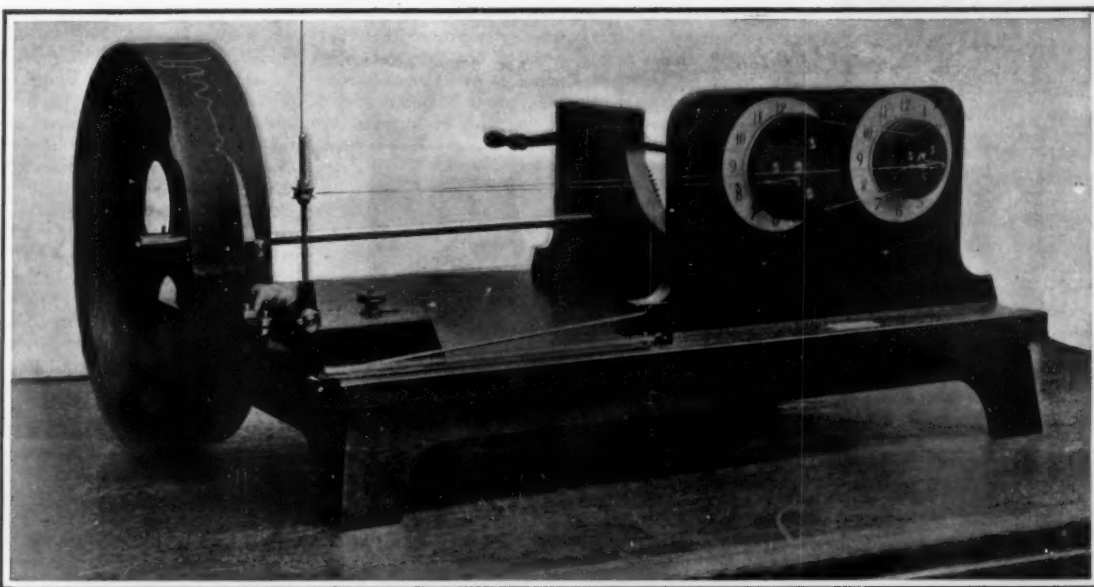


Fig. 2.—Apparatus for combining vibrations in the same plane.

driving pulley. The center of gravity can be brought accurately to the axis of rotation by means of sliding weights attached to two of the spokes. At one side of the drum a short pendulum, formed of a heavy cast-iron cylinder, is mounted on an axis perpendicular to that of the drum, on the blackened surface of which a record is traced by a flexible needle attached to the pendulum. The drum and the pendulum can be stopped, together or separately, by means of an adjustable lever, and the driver is also provided with an emergency brake.

With this apparatus some fifteen experiments can be

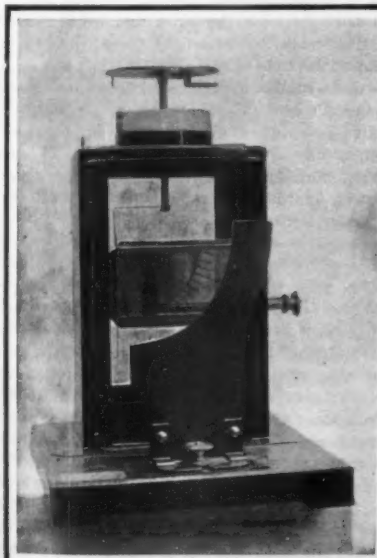


Fig. 4.—Chassagny's electroscope.

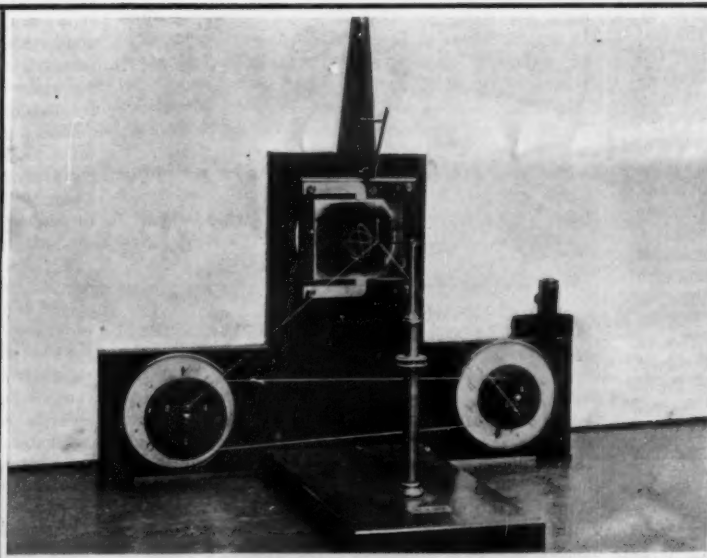


Fig. 3.—Apparatus for combining vibrations in mutually perpendicular planes.

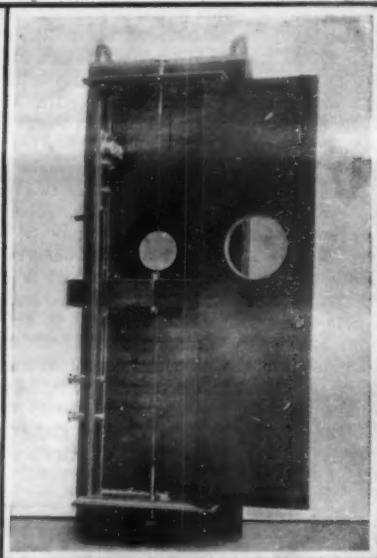


Fig. 5.—Chassagny's galvanometer.

A SIMPLIFIED METHOD OF TEACHING EXPERIMENTAL PHYSICS.

A New Process for Developing Photographs in Daylight.

If an ordinary dry plate, after it has been exposed in the camera, is placed in a bath of potassium iodide, the silver bromide is converted into the non-sensitive iodide, and the latter can then be developed in daylight with a suitable developer. It is recommended to carry out the process as follows:

The plate is laid for two minutes in an actual solution (i. e., four per cent potassium iodide). This can be done in a suitable cloth bag. After this the development may be carried out in subdued daylight using equal parts of the solutions A and B.

A.

Water	600 grammes.
Anhydrous sodium sulphite...	20 grammes.
Metal	1 gramme.
Hydroquinone	8 grammes.
Potassium bromide	40 grammes.

B. A three per cent caustic potash solution.

The plate should of course be rinsed before developing. The latter operation takes about five minutes. The fixing is carried out as usual, except that it takes a little longer. The exposure should be ample. The potassium iodide solution may be used over and over, but the developer should be mixed fresh for every plate.—*Chemiker Zeitung.*

Limitation of the Speed of Automobiles.

In England a recent municipal police ordinance requires high-power automobiles to carry apparatus which will give warning when the city speed limit is exceeded, or will automatically diminish the speed in such cases. An apparatus of the first class, which is much used, consists of an air-compressing cylinder prolonged at the bottom by a smaller cylinder containing a piston which has two peripheral vents and is forced forward by a spring.

The piston of the air-compressing cylinder is connected with the driving mechanism, and its velocity is proportional to the speed of the vehicle. So long as this speed is below the prescribed limit, the pressure of the air, which continually escapes through one of the vents of the small piston, remains too low to move this piston and compress the spring. When the legal speed limit is exceeded, however, the pressure rises, and the small piston is forced back until the second vent comes opposite a whistling vent in the wall of the small cylinder, so that the whistle is sounded by the escaping air.

An apparatus of the second class comprises an oil pump, the pipe of which is provided with a three-way cock. This cock is controlled by a centrifugal regulator and its third channel communicates with a cylinder containing a piston which controls the accelerator, the brake, and the transmission. When the speed exceeds the normal limit, this third channel is opened by the action of the centrifugal regulator, and the oil is forced into the cylinder where, by its pressure on the piston which operates the brake, etc., it reduces the speed of the vehicle to the normal limit. This limit is indicated on a dial, and it can be varied by adjusting the spring of the centrifugal regulator by means of a key.

The Current Supplement.

In the industrial development which the last one hundred years has witnessed, it may well be claimed that the industry of iron and steel stands among the foremost. Mr. F. W. Harbord in an interesting article in the current SUPPLEMENT, No. 1764, considers the various causes which have assisted in these vast developments; how on the one hand the engineer and chemist have made this progress possible, and how on the other hand the metallurgist, responding to the call of the varied modern requirements, has supplied the materials without which modern engineering developments would have been impossible. Dr. Alfred Gradenwitz tells how standard clocks are operated by wireless in the city of Vienna. The exhaustive review of recent improvements in the internal-combustion engine which has formed a feature of the last two numbers of the SUPPLEMENT is concluded. Mr. Fred W. Lane shows how a practical telephone may be employed. C. van Langendouck writes on the wonderful armored concrete viaduct of the Rotterdam and Scheveningen line. "The Seven Styles of Crystal Architecture" is the title of a paper which was read by Dr. A. E. H. Tutton before the Winnipeg meeting of the British Association for the Advancement of Science. That paper is published in the current SUPPLEMENT. Emile Gadeceau contributes a popular article on marine plankton. Under the title "The Red God of the Sky," a popular article on Mars and theories of Martian habitability is presented.

Blindly gunpowder contains 45 per cent chlorate of potash, 35 per cent of saltpeter, and 20 per cent of coal tar. In making it up, the tar is dissolved in benzine, the solution mixed with the salts and the benzine then evaporated.

SATURN AND HIS RINGS.

BY PROF. FREDERICK H. MONET, TRINITY COLLEGE.

The study of Saturn and his rings is one of the most fascinating in astronomy. The enormous bulk of the planet (second only to Jupiter in diameter); its low density (less than that of any other planet); the great difference between the polar and equatorial diameter; and the rapidity of its axial rotation, alone make Saturn an object of peculiar interest. But the conspicuous features of the Saturnian system, viz., the vast

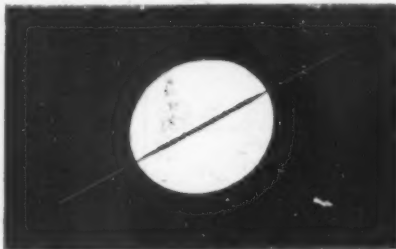


Fig. 1.—SATURN'S RINGS IN 1907.

rings and the brilliant retinue of ten satellites, which distinguish the planet from the other members of the solar system, constitute the problems of chief interest in the study mentioned.

Among the many advances in astronomical discovery is included a more accurate knowledge of Saturn's rings, the plane of which coincides with that of the planet's equator. It has been clearly proved that the theory of a rigid ring is untenable, and this view has long since yielded to the more scientific conclusion which maintains that the rings are in a mobile state, and that they are probably composed of swarms of

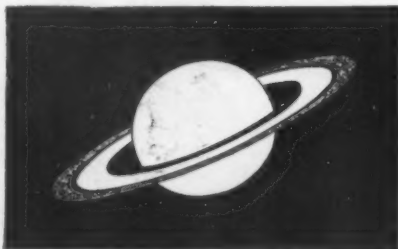


Fig. 2.—SATURN'S RINGS IN 1909.

meteors or satellites too small to be distinguished in the telescope. These bodies, obedient to the laws which govern the motions of satellites around their primary, would arrange themselves in the order as it now exists. The complexity of the problem is apparent. Since the thickness of the rings is not more than a hundred miles, and the diameter of the outer ring about one hundred and seventy thousand miles, the dimensions of these bodies must be very small, and their number extending over such a vast area well nigh incalculable. The installation at the present time of larger reflectors in our observatories augurs well for the value of observational work; and it is to be ex-

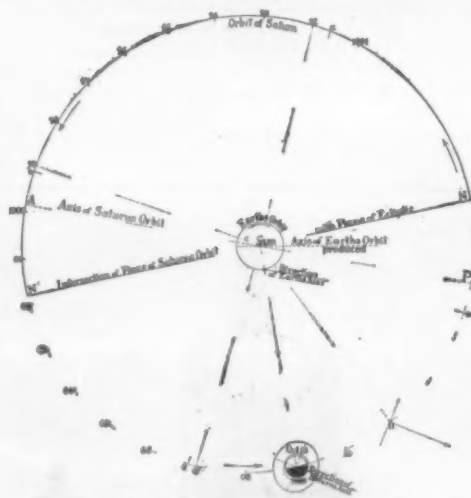


Fig. 3.—RELATIVE POSITIONS OF SATURN AND THE EARTH.

pected that in the future a more accurate knowledge of the constitution of the rings of Saturn will be obtained.

Saturn is now in that quarter of his orbit which includes perihelion. At an opposition which is near perihelion the planet approaches nearly one hundred million miles nearer the earth than at an aphelion opposition. As a consequence the apparent diameter of the planet and of the rings will increase at each opposition until perihelion is reached.

The plane of Saturn's orbit is inclined at an angle of

nearly $2\frac{1}{2}$ degrees to the plane of the ecliptic. In the diagram the full line represents that part of the orbit which is above the ecliptic; the dotted line the part below. The intersection of the plane of the orbit with that of the ecliptic is NN' , and these points are respectively the ascending and descending nodes. AP is the axis of the orbit whose center c is nearly fifty million miles from the sun. The revolution of the planet at a mean distance of 886 million miles from the sun is accomplished in nearly $29\frac{1}{2}$ years; oppositions occurring at average intervals of 378 days. The positions of Saturn at successive oppositions are shown from 1891 to 1911. The plane of the rings is inclined at an angle of 28 degrees to that of the ecliptic, and the plane traverses the earth's orbit twice during each revolution in opposite directions in a little less than a year (≈ 360 days). When it passes through the sun it is pierced by the planet's orbit at a and d , the positions of Saturn at opposite points in the orbit, which are reached at intervals of about fifteen years. When the planet is at either of these positions an edge view of the rings is presented to the sun. The extreme points of contact of the plane of the rings with the orbit are b and c ; and when Saturn is at either of these positions the rings are seen to the best advantage, i. e., they open to their greatest apparent width. The minor axis of the ellipse representing each ring is nearly one-half the length of the major axis.

At the date of the opposition of 1899 the planet was near b , and a satisfactory view of the northern hemisphere of Saturn and of the upper surfaces of the rings was obtained. At the opposition near c the southern hemisphere and the under or southern surfaces of the rings will be visible. Also the planet will be nearer the earth, and the apparent dimensions increased about one-eighth. Saturn will be in the northern heavens and therefore seen to good advantage in high latitudes. The plane of the rings traversed the earth's orbit in 1891-2. Fifteen years later, in 1907, this plane again crossed the earth's orbit, and an edge view was obtained. Fig. 1 shows Saturn and his rings in this position, making apparent the difference between the polar and equatorial diameters. The thickness of the rings is estimated between fifty and one hundred miles. But this measurement is so small in comparison with the diameter of the ring that it is impossible to represent it in correct proportion by the scale of the figure. The fine white line may therefore be accepted as a representation of the rings for a short period of time just before and after the edge view was presented, when they entirely disappeared, and the planet alone remained visible. The positions of Saturn and the earth are shown at the date of opposition in 1909. It is scarcely necessary to say that while the planets are correctly proportioned in the plot, their dimensions are enormously exaggerated in order to compare their magnitudes. If they were drawn to the scale of the orbits they would shrink to mere points. Saturn's axis moves parallel to itself. To an observer on Saturn (if life were possible on the planet) the heavens would appear to move in the same general direction as they appear to us, but around another pole, and in less than half the time, as Saturn's rotation on his axis is accomplished in about ten hours and a quarter.

Two years have passed since the edge view was presented to the earth. The rings are gradually widening, and their under surface becoming visible. Fig. 2 shows Saturn and his rings as seen in a telescope at the date of opposition this year. As the telescope gives an inverted image, in order to obtain a correct view Fig. 2 should be inverted. The larger area of the planet in the drawing represents the southern hemisphere which is turned toward the earth. The figure shows the division between the outer and inner rings, and between the "crane" ring and the planet. At each successive opposition the rings will widen and the markings on their southern surfaces will be more easily distinguished.

The present time offers an excellent opportunity for a telescopic study of Saturn and Mars. Both planets are evening stars, and both are near opposition. They are slowly approaching each other and will be in conjunction on December 31st.

Various salts added in small quantities to the water used in mixing Portland cement appreciably accelerate or retard the setting of the mixture. The setting is retarded by water containing 4 per cent or more of sodium chloride, and by weak solutions of calcium chloride, but the latter salt in concentration higher than 9 per cent acts as an accelerator. Aluminium chloride accelerates, while iron chloride, most soluble sulphates, and even plaster of Paris retard setting. Aluminium sulphate is an accelerator, and in the compound alums its effect preponderates over that of the retarding alkaline sulphates and produces a slight acceleration. The alkaline carbonates accelerate in weak solutions, but soda acts as a retarder when its concentration exceeds 10 per cent. Borax, boric acid, phosphates, chromates, and chromic acid in any concentration retard the setting.

Correspondence.

AN ODD PADDLE-WHEEL BOAT.

To the Editor of the SCIENTIFIC AMERICAN:

Among the odd boats in your recent issues, I failed to note a duplicate of one I saw in Canadian waters. It was a small excursion boat, sidewheeler, propelled by power furnished by a team of horses working on a treadmill. The speed was not great, but the boat surely moved, and furnished amusement for a goodly party which it happened to have the day I saw it. A band was playing and people shouting as we sped by on a steamer.

Utica, N. Y.

J. DOUX.

THE HEIGHT OF MOUNT RAINIER.

To the Editor of the SCIENTIFIC AMERICAN:

Reading to-day in a recent issue of the SCIENTIFIC AMERICAN, I saw this statement in reference to Mount Whitney: "This peak is the highest in the United States." Height given, 14,501 feet.

I was with Prof. McClure in 1897 when he ascended Mount Rainier, and helped him to carry instruments for use in determining the height. Although he was killed in the descent, his notes were complete, and the subsequent calculations made from them by his friends gave the height as 14,528 feet above sea level. I believe these figures have been accepted as the true height.

HARVEY F. MITCHELL.

New York city.

THE SCIENTIFIC AMERICAN AT JERICHO.

To the Editor of the SCIENTIFIC AMERICAN:

I inclose you a portion of your issue of February 7th, 1885, which was given me by a friend of mine, Dr. Herman Bryan, a returning medical missionary from the island of Hainan. Dr. Bryan took a trip through the Holy Land, and found in the reading room of Cook's Hotel at Jericho, on April 10th of last year, a copy of this issue, which was the sole American reading matter provided by the hotel management. Dr. Bryan has returned to China now, but he asked me to mention this to you, and suggest that the SCIENTIFIC AMERICAN might well be represented by a more recent copy.

ALEX. L. PUGH.

New York city.

WHY NOT A MONUMENT TO FITCH?

To the Editor of the SCIENTIFIC AMERICAN:

It gave all members of my family great pleasure to read the SCIENTIFIC AMERICAN editorial of October 9th. It strikes the keynote of the situation in regard to our unequal distribution of acknowledgment to steamboat inventors. My father (James Arthur) pronounces it the best column that has appeared to date.

We of course all realize that it is impossible to do honor to all the early inventors, but we should at least do justice to the United States of America by placing its steamboat successes in the right century. We have just been celebrating the fact that the United States had a steamboat in the nineteenth century while as a matter of fact we had several successful ones in the eighteenth century, and the one referred to in your editorial attained a speed which was not exceeded until the following century was several years old.

We all hope that your timely remarks will bear fruit and that a bronze tablet will be placed near Collect Pond, and that the grave of John Fitch may at least be properly marked.

DANIEL ARTHUR.

New York, N. Y.

"INFLEXIBLE" AND "CONNECTICUT" COMPARED.

To the Editor of the SCIENTIFIC AMERICAN:

Pardon me for the presumption of criticising anything in your very valuable paper, but an article in the issue of October 9th, dealing with the visiting warships anchored in the Hudson River, I think is misleading in one particular. In comparing the broadside fire of the three battleships representing France, England, and the United States, the statement is made that the "Inflexible" has eight 12-inch guns which can be fired on one broadside. But, if I am not mistaken, the "Inflexible," like all her sister "Dreadnoughts" of the English navy, is unable to fire all her 12-inch guns on both broadsides, on account of the position of the two wing turrets. If this is true, then the "Inflexible's" superiority would be mainly in her great speed. I believe that the "Connecticut," with her rapid-fire 8-inch and 7-inch guns, coupled with her four 12-inch guns, would more than hold her own with an "Inflexible." Although the 8-inch and 7-inch guns, theoretically, will not penetrate the "Inflexible's" amidship armor belt, still the rain of shells from these lighter guns would play havoc with every part of the vessel above the low 7-inch armor belt of the English cruiser. This would not affect the crews in the 12-inch turrets, but when the ship is riddled fore and aft, with all the upper works, containing all the range-finding apparatus, carried away, it would tend to demoralize the entire personnel. The article also mentions that the "Inflexible" could close in to a range of 6,000 yards

and quickly overcome the "Connecticut," by the mere concentration of her 12-inch guns. Now, I think it would be extremely unhealthy for the "Inflexible" at this range, as the terrible broadside of the "Connecticut's" four 12-inch, four 8-inch, and six 7-inch guns would completely overwhelm the six 12-inch of the former. Even admitting that the 7-inch guns of the "Connecticut" are protected with comparatively light armor, still the tremendous rate of fire of that battery, in addition to the four 8-inch and four 12-inch, would so blind the gunners on the enemy, that they would be unable to properly handle their guns. Even up to 9,000 yards, the 8-inch and 7-inch guns would be very effective in carrying away the upper works of an enemy, thus destroying his ability to handle his ship. So I would like to see our "Connecticut" placed in a more favorable light in a comparison with the "Inflexible."

EMERSON B. MANLEY.

U. S. S. "Kansas."

Machinist's Mate.

[We mentioned in the article referred to that the secondary battery of the "Connecticut" would riddle the unprotected parts of the "Inflexible." The midship pairs of 12-inch guns on this ship are placed diagonally, and therefore all four guns can be fired on either broadside, through a limited angle.—Ed.]

RESULT OF A LIGHTNING STROKE.

To the Editor of the SCIENTIFIC AMERICAN:

The accompanying photograph was taken recently at Velva, N. D. Three young men were putting up hay, when a thunderstorm came up, and all three were knocked down, the lightning killing a team of horses, and rendering the two men who were holding them unconscious for some hours. The third man saw the others fall, and then lost consciousness himself. His



RESULT OF A LIGHTNING STROKE.

team, standing a couple of rods away from the other, was knocked down, and a hole was torn in his cheek, whether from the fall or from the lightning it might be impossible to say. He came to, mounted a horse, after pulling one of his companions from under one of the dead animals, and rode for help. Securing that, he returned, and then fainted, partly from loss of blood, and remained unconscious several hours. The other two men regained consciousness that night, and all three were practically over the effects of the stroke within a week after the occurrence. The photo shows a new pair of shoes worn by one of the men, and a new, heavy pair of overalls, just as they were taken from him after the accident.

HUGH J. HUGHES.

Agricultural College, N. D.

THE NUMBER OF OUR ANCESTORS.

To the Editor of the SCIENTIFIC AMERICAN:

If you and your readers are not tired of this question, may I suggest another solution than that Mr. Solon De Leon gives? I may perhaps point out that, originally, I simply stated the problem, did not say it vexed me, and made no false sociologic assumption.

Let X represent the first generation, and so assume $X=2$. Assume continuity of descent, and let X_v represent some later generation. We need not trouble about what value we give to y ; all we want is that the number of individuals of the generation is represented by X_v . We get, say, 20,000,000 of individuals descended from 2 original individuals, and see at once that there is some consanguineous relationship between all the individuals of the X_v generation. So,

If we assume all of us now existing are descended from some original man and woman, it is clear we are all of us consanguineously related.

Now consider any one individual existing at the present time. Then his parents are consanguineously related, but in most cases the blood relationship is so remote that he will treat the relationship as non-existent. We have, in the simple form of the problem I use, a series, X, X^2, X^3, \dots, X_v , where each individual of the X_v generation relates back in consanguinity to the original generation X ; but there being so many intermediate generations, his collateral consanguinity to any other individual of his generation is so remote that to him it is non-existent. For an example of this we have the fact that man as an organism is related to the monkey as an organism through some arboreal ancestors. But the collateral consanguinity is so remote, that we treat it as non-existent.

F. C. CONSTABLE.

Wick Court, near Bristol, England.

THE HIGHEST HUMAN ASCENT.

To the Editor of the SCIENTIFIC AMERICAN:

On page 239 of your issue of October 2nd, 1909, you state: "The record of altitude in aeronautics has been attained by Sig. Placenza and Lieut. Mina, in an ascension made from Milan on August 10th, 1909. Their great spherical balloon . . . reached an elevation of 38,700 feet, or more than seven miles." This statement, based probably on the press reports, is incorrect, as proved by a letter from the aeronauts themselves, Messrs. Mina and Placenza, published in the French journal *L'Aérophile*, of September 1st, from which it appears that the maximum height was only about 9,200 meters, or 30,180 feet. Since their cotton balloon held only 80,500 cubic feet and contained illuminating gas, this was a remarkable performance; and though there is some doubt as to the barometric observations, it probably exceeds both the French and Italian records. The world's record is, however, still held by Messrs. Berson and Süring, who ascended from Charlottenburg, near Berlin, on July 31st, 1901, in a balloon of nearly 300,000 cubic feet capacity partially filled with hydrogen gas, to the height of 34,450 feet.

A. LAWRENCE ROTCH.

Blue Hill Observatory, Hyde Park, Mass.

AERIAL WARFARE IN 1798.

To the Editor of the SCIENTIFIC AMERICAN:

In connection with the letter published in your issue of September 18th it may be of interest to cite an earlier suggestion of invading England by balloon. In R. P. Heame's "Aerial Warfare" a copy of a print of 1798 is reproduced from the collection of Capt. Baden-Powell, and this print bears the following inscription:

"The Grand Republican balloon intended to convey the Army of England from the Gallic shore; for the purpose of exchanging French liberty for English happiness! Accurately copied from a plan presented to the executive directory by Citizen Monge."

The Grand Republican balloon is depicted as having a spherical gas bag to which is suspended, by means of rope ladders, a peculiar contrivance half ship and half house. On top of the gas bag is the Gallic cock holding a tri-color surmounted by a liberty cap. Halfway down the sphere is a great circle on which is encamped a detachment of troops and a gullotine. Pipes to let out the inflammable air also appear, while a pair of ornamental wings are noted. A small captive balloon to serve as a boat is fastened to the great circle from which a lighthouse juts out.

The lower portion is a jumble of houses and sails with apartments for the officers in the hold. Below this again is the magazine suspended by cables, while a box-like structure on one side bears the designation of "water closet." The print bears the mark of a London publisher and forms an interesting addition to the cartoons of that period.

GERALD ELLIS CHONTIN.

The operation of the 1,200-volt direct-current system of interurban railway control is dealt with by Mr. C. D. Eveleth in a paper read before the Street Railway Association of the State of New York. Four lines have adopted the system in America. The obvious advantages, assuming that there are no drawbacks, which Mr. Eveleth sets out to demonstrate, are that the first cost is low, maintenance is not more expensive, and extensions to existing lines can be entered upon with much more ease and confidence. There are now in operation or under contract eleven systems of 1,200-volt direct-current railways, employing motors of 50, 75, and 150 horse-power, and Mr. Eveleth predicts that in a few years the 1,200 voltage will be as common as 600. The cars can be easily operated on 600-volt sections where necessary. Those electrical engineers in Great Britain who still hope that the authorities will some day "encourage" the construction of rural and interurban light railways will welcome these American experiences as suggesting further sources of economy in rendering their schemes commercially attractive.

THE LATEST SUBMARINES OF THE UNITED STATES NAVY.

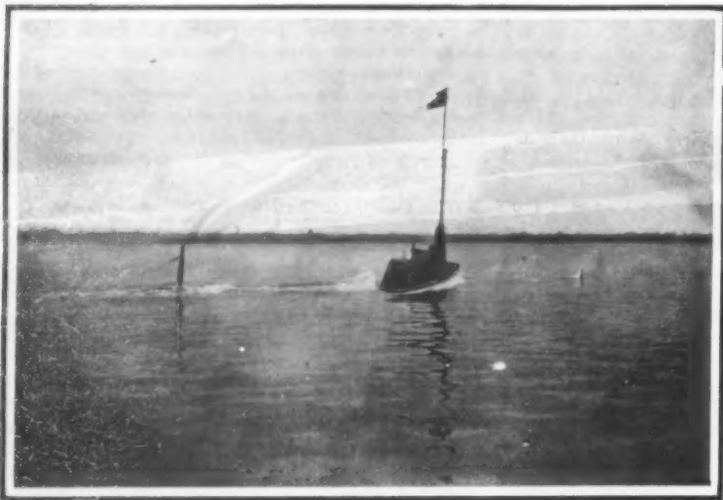
As in all mechanical development an improved type of any particular device is an evolution from its predecessors, so in general, the modern Holland torpedo boat, of which the government is now building a number, is a descendant of the original little craft of that name, which first made its appearance at the close of the Spanish war.

below the surface of the water. At these depths the pressure of the water is great, so that the hull must be made sufficiently strong to withstand it.

Up to the present, it has been found that the most efficient size for a boat is about 140 feet long and 14 feet in diameter. With such dimensions, a boat can be built which will fulfill all requirements which the naval authorities of the world demand from it. That is to say, it can cruise on the surface for long dis-

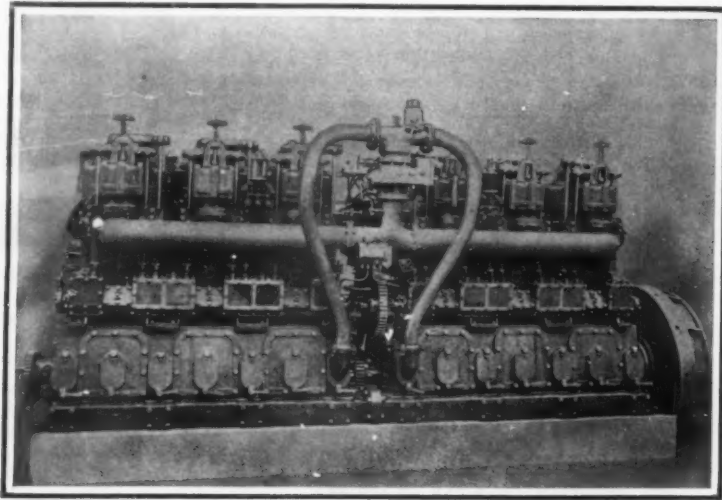
pletely submerged with nothing visible above water, for a distance of 150 miles.

There are two distinct conditions in which the boat may be used. In the first, commonly known as the surface condition, the boat is prepared for cruising. A considerable portion of her hull is above water, a removable navigating bridge is in place, and she is driven by large, powerful, internal-combustion engines. Under these conditions she is managed in about the



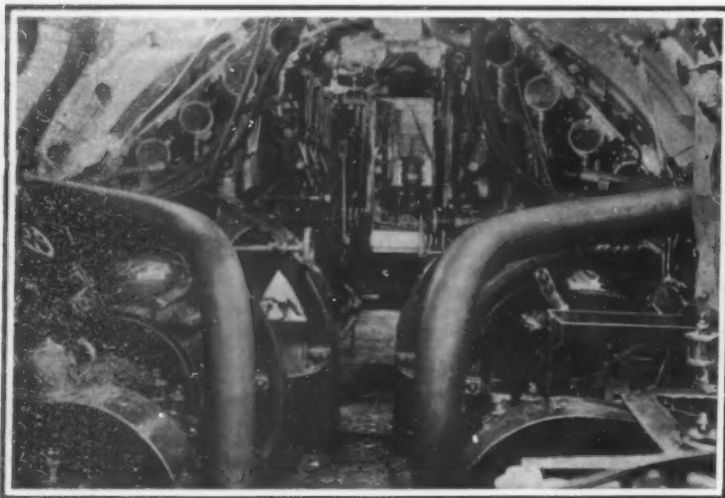
The dark object in the center is the conning tower. The periscope to which the flagstaff is attached projects above water when the boat is submerged and by its means the commanding officer can view surrounding objects as clearly as though he looked through a field glass at the surface.

Submarine beginning to dive.



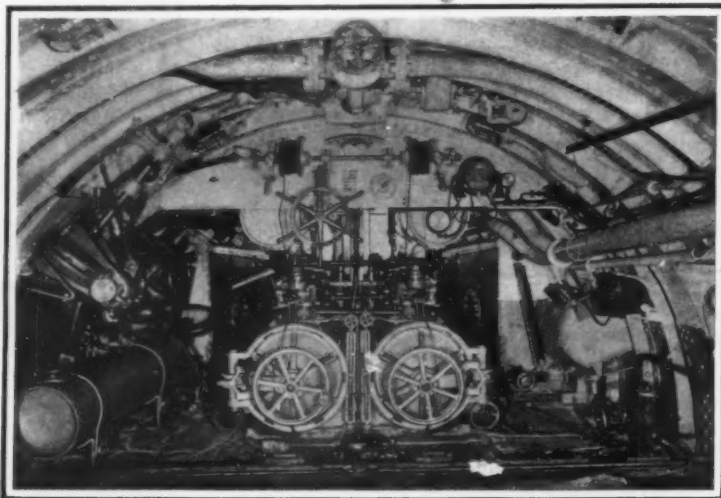
These engines are used only in traveling at the surface. They can drive the boat at 14 knots. For submerged work they are uncoupled and the boat is driven by two electric motors. The latter take their energy from storage batteries which have been charged by the gas engines.

One of the twin internal-combustion engines of the submarine.



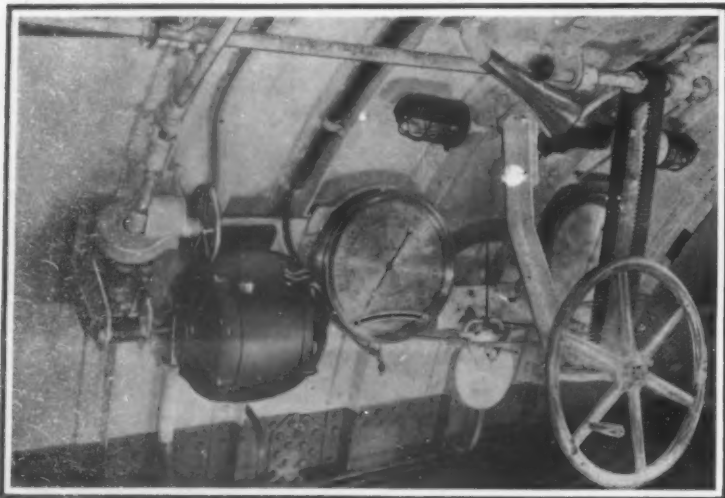
To right and left are the electric motors which drive the boat, when submerged, at 10.5 knots per hour.

Looking aft in engine room.



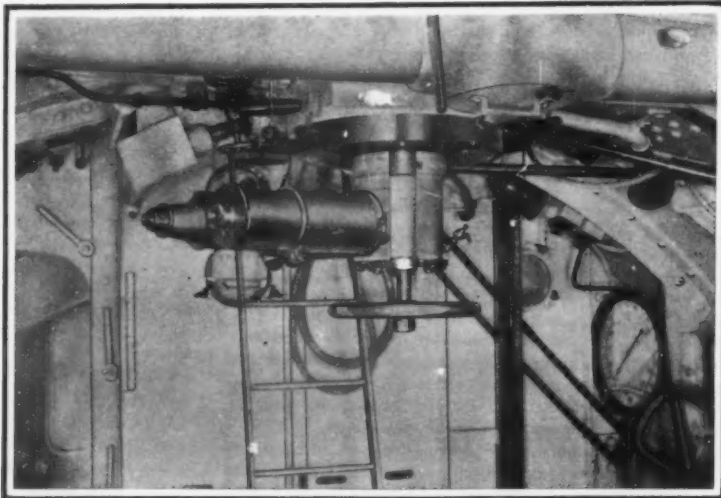
In the center are the two torpedo discharge tubes. To the left is the electric motor and gear by which the doors in the nose of the submarine are opened for discharge of torpedoes.

View on main floor looking forward.



The hand wheel to the right operates the diving rudders used for steering in a vertical plane. In front of the wheel is a gauge whose pointer shows the depth in feet of the boat below the surface. The curved dark line below pointer is a spirit level which shows the inclination of the boat.

Diving wheel and depth pressure gage.



This shows the roof, not the floor, of the submarine interior. The horizontal eyepiece and the vertical telescope tube are rotated by means of the hand-wheel whose pinion engages an internal gear ring.

Eyepiece at bottom of periscope.

THE LATEST SUBMARINES OF THE UNITED STATES NAVY.

The form of hull is generally described as cigar-shaped. It is built of the very best quality of mild steel, and the workmanship is of the highest order, for the reason that every seam and rivet must be perfectly tight, in view of the service which the boat is called upon to perform. Not only do vessels of this type undergo all the stresses of sea and weather which other vessels are subjected to, but in addition they are required to navigate at considerable depths

at a speed of fourteen knots. At lower speeds its radius of action extends to several thousand miles. For submerged work large storage batteries are provided, which furnish energy sufficient to drive the boat from ten to eleven knots for a period of over an hour. The same electrical energy will drive her at a lower speed for a much longer time. The latest submarines, built for the government by the Fore River Company, at about five knots speed can run com-

same way as any vessel built to run upon the surface. As for sea-going qualities, our submarines have been found in practice to be excellent. In ordinary weather they are fully as comfortable as any surface craft of the same dimensions, and even in the heaviest weather they are entirely seaworthy.

The second distinct condition exists when the boat is submerged. To pass from the surface to the sub-

(Continued on page 305.)

AN ALL-SEEING EYE FOR THE SUBMARINE.

Vision under water is limited to but a few yards at best, and hence a submarine boat, when submerged, would be as blind as a ship in a dense fog and would have to grope its way along guided only by chart and compass, were it not for a device known as a periscope, that reaches upward and projects out of the water, enabling the steersman to view his surroundings from the surface. Of course the height of the periscope limits the depth at which the craft may be safely sailed. Nor can the periscope tube be extended indefinitely, because the submarine must be capable of diving under a vessel when occasion demands. But when operating just under the surface, where it can see without being seen, the craft is in far greater danger of collision than vessels on the surface, because it must depend upon its own alertness and agility to keep out of the way of other boats. The latter can hardly be expected to notice the inconspicuous periscope tube projecting from the water in time to turn their great bulks out of the danger course.

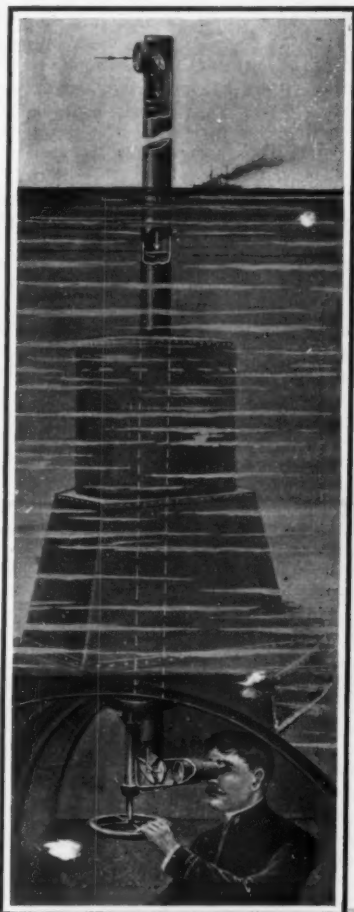
The foregoing article describes the type of periscope now in common use on submarines and one of the engravings on this page clearly illustrates the principles of the instrument. A serious defect of this type of instrument is that the field of vision is too limited. The man at the wheel is able to see under normal

jectives *C* and *D* (Fig. 3) between which a condenser *E* is interposed at the image plane of the lens *C*. At the bottom of the periscope tube the rays are reflected by means of a prism *F* into the eyepiece. Two eyepieces are employed. One of low power, *G*, is a Kellner eyepiece, the purpose of which is to permit inspection of the whole image, while a high-powered eccentrically placed Huyghenian eyepiece, *H*, enables one to inspect portions of the image. The two eyepieces are mounted in a rectilinear chamber, *I*, which may be rotated about the prism at the end of the periscope, thus bringing one or other of the eyepieces into active position. The plan view, Fig. 4, shows in full lines the high-powered eyepiece in operative position, while the dotted lines indicate the parts moved about to bring the low-powered eyepiece into use. A small catch, *J*, shown in Fig. 2, serves to hold the chamber in either of these two positions. The high-powered eyepiece is mounted on a plate, *K*, which may be rotated to bring the eyepiece into position for inspecting any desired portions of the annular image. The parts are so arranged that when the eyepiece is in its uppermost position, as indicated by full lines in Fig. 2, the observer can see that which is directly in front of the submarine, and when the eyepiece is in its low position, as indicated by dotted lines, he sees objects to the rear of the submarine. With the eyepiece at the right or

Red and White Meat.

The flesh of cattle, sheep, horses, wild hogs, deer, hares, pigeons, ducks, geese, and salmon is red or dark colored, while the flesh of calves, domestic hogs, rabbits, trout, pike, all flat fishes, lobsters, and crabs is white or pale. In fowls, white meat is found in the breast, dark meat in the legs and thighs. The contrast is most sharply marked in wild fowl. In frogs, on the contrary, the legs are white and the rest of the flesh is dark. The mackerel, the eel, and many other kinds of fish also have both white and dark flesh.

Knobloch has shown that this anatomical distinction between white and dark muscles runs parallel with the distinction between agile and sluggish muscular fibers, which has been established by physiological experiment. In general, pale muscles are more active than dark or red muscles. They contract more quickly, but they become fatigued sooner than the dark muscles, because they produce, in performing the same amount of work, a larger quantity of lactic acid, which is the fatigue product of muscles. The two classes of muscular fibers differ also in sectional dimensions. The adductor, or shell-closing, muscle of the mussel consists of a white and a gray portion, which can be clearly distinguished from each other, and the presence of both kinds of fibers is explained by the habits of this mollusk.



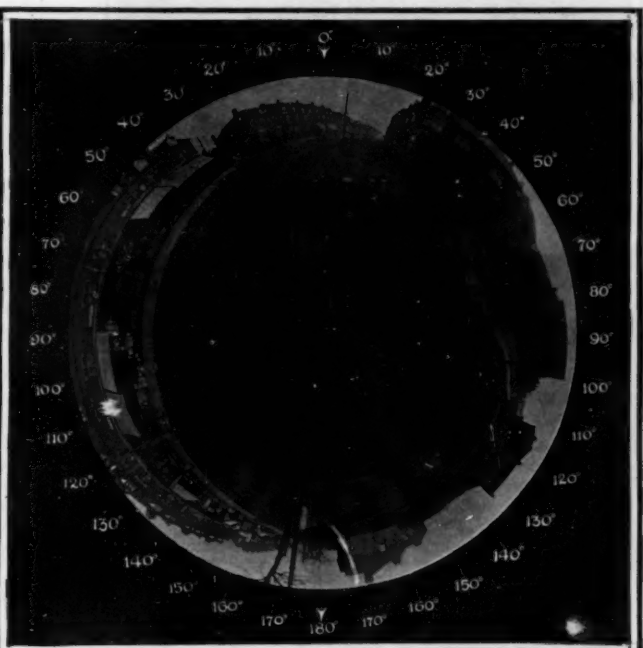
Periscope in general use.



The universal observation lens.



The periscope top.



A photograph taken with the periscopic universal lens.

FORMS OF PERISCOPES FOR SUBMARINES. THE EYE THAT LOOKS IN ALL DIRECTIONS AT ONCE.

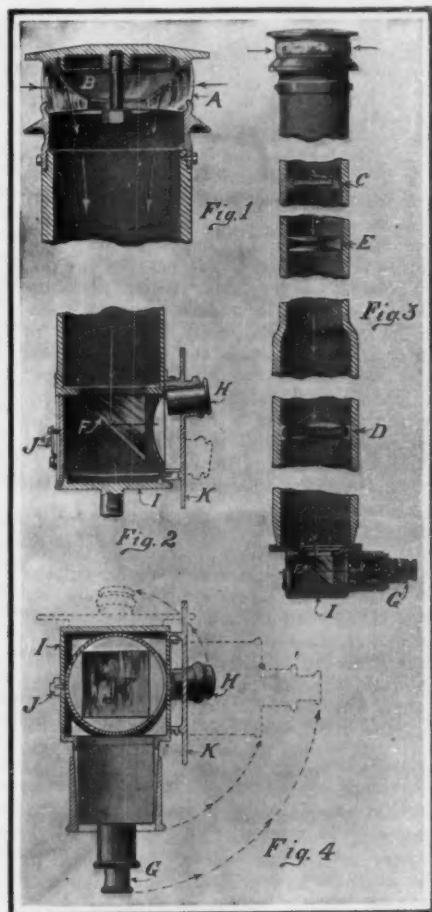
conditions only that which lies immediately before the boat. It is true that he can turn the periscope about so as to look in other directions, but this, of course, involves considerable inconvenience. On at least two occasions has a submarine boat been run down by a vessel coming up behind it.

As long as the submarine has but a single eye it would seem quite essential to make this eye all-seeing; and since the two lamentable accidents just referred to, an inventor in England has devised a periscope which provides a view in all directions at the same time. This has been attempted before, but it has been found very difficult to obtain an annular lens mirror which would project the image down the periscope tube without distortion. The accompanying illustrations show how this difficulty has now been overcome. While we will not attempt to enter into a mathematical explanation of the precise form of the mirror lens, it will suffice to state that it is an annular prism. The prism is a zonal section of a sphere with a conoidal central opening and a slightly concave base. All the surfaces, however, are generated by arcs of circles owing to the mechanical inconvenience of producing truly hyperboloidal surfaces. The lens mirror is shown in section at *A* in Fig. 1. The arrows indicate roughly the course of the rays into the lens and their reflection from the surface *B*, which is preferably silvered. The tube is provided with two ob-

jectives at the left he sees objects at the right or left, respectively, of the submarine. The high-powered eyepiece is slightly inclined, so that the image may be viewed normally and to equal advantage in all parts. Mounted above a plain unsilvered portion of the mirror is a scale of degrees which appears just outside of the annular image. A scale is also engraved on the plate *K* with a fixed pointer on the chamber, making it possible to locate the position of any object and rotate the plate *K* so as to bring the eyepiece *H* on it. The scale also makes it possible to locate the object with respect to the boat.

This improved periscope is applicable not only to submarine boats but for other purposes as well, such as photographic land surface work, in which the entire surroundings may be recorded in a single photograph. The accompanying photograph taken through a periscope of this type shows the advantages of this arrangement and gives an idea of its value to the submarine observer when using the low-powered eyepiece. Of course, by using the other eyepiece any particular part of the view may be enlarged and examined in detail.

Cement for Meerschaum.—Stir very fine meerschaum chips with white of egg or dissolve casein in water glass, stir in finely powdered magnesia and use the cement at once. It hardens very quickly.



British periscope with universal eye.

The mussel propels itself through the water by quickly opening and closing its shell, but in the presence of danger it keeps its shell closed for long periods. The rapid swimming movements are started by the pale and agile muscular fibers and maintained by the automatic operation of the dark, sluggish fibers, which also serve to hold the shell closed. The same biological law of division of labor appears to govern the character of the muscular structure of higher animals. The relative proportions of pale, agile fibers and dark, sluggish fibers are determined by the method of locomotion. The incessantly leaping frog possesses a much larger proportion of white muscle than the slowly creeping toad. The leg muscles of fowls are dark because the legs almost continually support the weight of the body, but the breast muscles are white because the wings are used only occasionally, and for short periods. The dove, continually on the wing, has dark-colored breast muscles. The flesh of the sportive calf and lamb is white, while that of the contemplative cow and sheep is red. The ever-active heart and respiratory muscles, and the very frequently-used muscles which move the eyes and jaws, are red. The flesh of calves and lambs and the white legs of young chickens darken with advancing age. Knobloch infers that the white muscles represent the primitive stage, through which every dark muscle has passed.—Prometheus.

COL. JOHN JACOB ASTOR'S NOVEL STEAMSHIP CHAIR.

Many people in crossing the ocean have experienced inconvenience by reason of the fact that the chairs in the saloon and card-rooms are rigidly screwed to the floor. The chairs are secured at such a distance from the tables that they will accommodate persons of very ample proportions, and, therefore, when a comparatively thin person occupies a chair, he finds it necessary to sit merely on the edge, for should he endeavor to lean back in the chair, he finds himself too far from the table.

While recently returning from Europe, Col. John Jacob Astor conceived of a very simple and practical scheme whereby the chairs may be firmly held in place at any desired distance from the tables or may be easily released and moved about. Col. Astor's scheme involves the use of a vacuum cup beneath the chair and so mounted that it may be pressed into engagement with the deck or floor to hold the chair by suction, or the vacuum may be broken, the cup lifted, and the chair released.

If the chair is on a deck or hardwood floor or on rubber tiling, the vacuum will hold indefinitely, while if used on a carpet it will probably be necessary to depress the cup and raise it again occasionally to form a new vacuum. This device will undoubtedly add greatly to the comfort of the traveling public, as chairs may then be quickly and securely fastened at the desired distance from the table to accommodate either fleshy or thin persons. Col. Astor intends to present this invention to the public, as has been his custom with all his recent inventions.

Gold Dredging in Alaska.

BY GEORGE E. WALSH.

The continued exploitation of new gold fields by the big gold dredges in different parts of the world has given to this industry many new points of economy which the companies are taking advantage of. The great districts where the gold dredges have been in most successful operation are Australia, California, and Alaska. In both of the former places the wholesale dredging of the ground by the mammoth "gold ships" has caused some trouble with the official authorities, and the question of restoring the dredged fields to something like their former condition has been adjudicated in the courts.

In Australia the work of reclaiming the dredged ground has been accomplished by advance stripping of the surface soil, so that this can be separated from the coarse sand and silt from below. The surface soil is first stripped and deposited in separate places before the gravel is touched; and then after the dredging is completed, the surface soil is replaced, so that the land can be used for other purposes. In California, where the gold ships threatened to interfere with the flow of the rivers, the dredging companies have been compelled by the State authorities to restore the dredged land in certain districts, so that the normal water flow will not be interrupted.

No such trouble, however, is found in Alaska, where gold dredging has been carried on extensively in the past year or two. Alaska is more suited to this form of gold mining than any other country, and great stretches of river soil await the companies with dredges. When the first big gold dredge was shipped to Alaska in sections and then assembled there, it was looked upon as a very uncertain investment. Owing to the short open season when the dredges could be operated, and the great cost of getting the dredges into the distant mining regions, it was not looked upon with favor by capitalists.

Subsequent events and experience have changed all of this. In the first place, the enormous area of gold land suitable for bucket dredging makes it possible for the gold ships to operate indefinitely without being transported to new regions. In fact, the field is almost inexhaustible. Consequently, the investments in the big dredges cannot prove other than very profitable, even if for the first year or two they could make little. But even with the comparatively short open season when the ground is not frozen hard, the gold ships have proved extremely profitable, and the fleet up there has steadily increased from year to year.

In California, where the gold dredges can be operated the year around, the dirt yields on an average only 15 cents per cubic yard, and yet with this low yield the work is very profitable. On the other hand, the placer fields of Nome run from \$1 to \$20 per cubic yard, which accounts for the fact that the dredges make more money in their short summer season than the California dredges can do in twelve months of the year. A five-foot bucket dredge can wash as much gravel as 3,000 men can do by hand, and consequently it can secure a profit on dirt so low in grade that hand washing is utterly impossible.

There are more than a dozen gold dredges now in operation in the Nome district, and every one of

these is earning big profits. The Guggenheims of New York have been operating three dredges for several years, and several new ones are now in the course of construction. The Nome Gold Dredge and Power Company, composed chiefly of New York capitalists and engineers, has installed several more dredges in the Nome district. This concern owns or controls nearly 2,000 acres of placer ground, which on a low estimate yields about \$3.50 of gold per cubic yard.

It costs about \$120,000 to get one of these dredges up in Alaska and ready for operation in the placer district, but such a dredge will yield a net return of nearly \$600,000 per year. Such enormous returns on the investment certainly justify the installation of new dredges. A dozen such dredges now in operation in Alaska yield annually several million dollars' worth of gold, and most of this is reclaimed from districts that the hand operating companies overlook. The craze for new districts that yield enormous returns continues to attract the average miner, and he passes over unnoticed the placer mines that prove rich harvests to the dredge companies. There is no interference by State authorities with dredging in Alaska, and no thought or consideration of restoring the surface after operations enters into the calculations of the companies.

The character of most of the gravel in the Nome district makes it ideal for either dredging or hydraulicking. It is almost entirely free of large boulders, clay substances, and roots which might obstruct the operations of the dredge or sluicing apparatus. The



COL. JOHN JACOB ASTOR'S IMPROVED STEAMSHIP CHAIR.

placer lands lie for the most part in valleys between sloping hills. This land is covered with snow early in the fall, and thus prevents hard freezing. As a result, dredging operations can begin as early as the first half of June and continue fully four months, or for about 120 days. This makes a season's work, and then the dredges have to stop operations for the long winter. It seems like a very short season for mining operations, but owing to the character of the soil and the gold yield, it proves very profitable.

Before an investment is made in a gold dredge of this character, the placer land is first carefully investigated and the probable gold output estimated. Thus, before the first dredge was shipped to Alaska, upward of a hundred shafts were sunk to depths ranging from 10 to 15 feet, and the lowest yields of gold were found to be \$3.50 per cubic yard, while in the river beds the gold often ran as high as 15 cents per pan, or over \$20 per cubic yard.

Except at the foothills, the dredge companies around Nome have never yet struck bedrock, and the lowest shaft put down was 15 feet in depth. Further sinking was prevented by the shafts filling with water, but from every indication the bedrock is at least 25 to 30 feet below the surface. This bedrock is composed of mica schist and slate. In all the dredging operations of these placer mines, the values increase more steadily at bedrock than at higher points; and even from 6 to 18 inches into the bedrock the returns are large. The whole character of the land is ideal for dredging, and there is plenty of water for as many dredges as could possibly be used.

The fact is, the coming of the big gold dredges in Alaska and their successful operation, with unlimited

possibilities for work for many years to come, has marked a new era in mining for the precious metal in this far northern country. It is the beginning of the end of aimless, unscientific gold mining. The great finds of gold where prospectors can pick up gold in quantities are no longer so common as a few years ago. The field has been pretty nearly investigated, and the character of the mining must change to suit new conditions. This means that the influx of fortune hunters will gradually cease, and mining will fall into the hands of companies, who are willing to get their returns gradually through improved, though somewhat expensive, methods of work. A great many owners of ordinary placer claims are today renting out their land to gold-dredging companies, and others are organizing for the purpose of installing their own dredges. Taking the returns for a period of five or ten years, the profits of a gold dredge company are infinitely higher than another which depends entirely upon making rich finds and then gathering the surface gold for quick returns. Gold dredging in Alaska is thus an infant but lusty industry, and its growth in the next few years must be phenomenal and steady.

Has the Earth's Climate Changed in Historic Times?

The explorations in Central Asia have laid bare the ruins of once flourishing cities. M. Boutquin, in the French journal *Ciel et Terre*, proves, by historical evidence and modern scientific discoveries, that the abandonment of these regions by the human race was brought about by causes entirely unrelated to such supposed meteorological changes as a general cooling of climates or a progressive desiccation of the globe. In Europe, for example, a sensitive lowering of the temperature and decrease in the precipitation of rain and snow would have caused a well-marked and continuous recession of glaciers, but no such recession is shown by the records of more than two thousand years. Heim has proved that, although the glaciers of the Alps receded during the latter half of the nineteenth century, they are now far more extensive than they were in the Middle Ages.

Polybius, in the second century B. C., described the rich gold and silver mines of the Tyrol. These mines yielded abundantly until the middle of the sixteenth century, after which date their productiveness rapidly diminished because the mouths of shafts became covered with ice. A shaft sunk at this epoch was covered in 1570 by a glacier 65 feet thick. Resistance to the invasion of the ice soon became impossible. In the eighteenth century the glacier was more than 300 feet high, and in 1875 it had attained a height of 460 feet.

For many years it was asserted that the east coast of Greenland had formerly enjoyed a mild climate, which favored the growth of vegetation and gave rise to the name Greenland. The historical researches of Rink and Von Maurer, however, have proved that the decay of the posts established by the Norwegians in olden times was caused by the introduction of a contagious disease and by the adoption, by the Norwegian government, of an unwise economic policy, which provoked hostile attacks by the Eskimos. Equally erroneous statements have been made in regard to Iceland.

In the British Isles, the cultivation of wheat formerly extended much farther north than it does at present, simply because it was then, in the absence of foreign competition, more profitable than it is now. Yet it has been very difficult to gain acceptance for this elementary truth; the popular belief in a change of season or climate for a long time prevailed over all evidence.

In Belgium and other countries, also, agriculture has been radically transformed by the operation of economic laws, improved methods of culture, and a more intelligent choice of crops. In the Middle Ages and until the fifteenth century the vine was cultivated in Bavaria and in other parts of Germany from which it has now almost entirely disappeared, but its disappearance is not due to climatic changes. The wine produced in these districts was generally of inferior quality and, with the growing refinement of taste, it was gradually supplanted by foreign wines and good native beer.

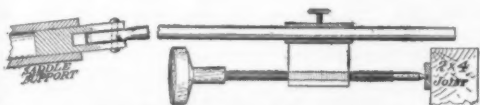
The culture of the vine has practically disappeared from Belgium for similar reasons. Two Belgian abbeys still possess vineyards and make wine for sacramental use. In France, it has been proved that the vintage season has not shifted appreciably since the fourteenth century. It has likewise been demonstrated that, contrary to the popular belief, the olive was never cultivated in Switzerland except to a very small extent in gardens, and that no change has occurred in Swiss agricultural products in general.—*Cosmos*.



AN EASILY CONSTRUCTED EQUATORIAL MOUNT FOR SMALL TELESCOPES.

BY PROF. R. W. WOOD, JOHNS HOPKINS UNIVERSITY, BALTIMORE.

In the course of some experiments which I have been making at my summer laboratory in East Hampton, Long Island, on the photography of the moon in ultra-violet light ($\approx 3,100-3,200$) it became necessary to provide an equatorial stand with a slow-motion screw for accurate following. As a polar axis is often desired in a hurry for special work, and as there are doubtless many amateurs who sometimes feel the need of such a stand, it seems worth while



THE SLOW-MOTION SCREW.

to give a short description of a very efficient, though hurriedly improvised, one which I constructed for my purpose.

It was made from the frame of a discarded bicycle, the bearings of the steering rod being, however, in good condition, with little or no lateral movement. The wheels, sprockets, saddle, etc., were removed, and the frame stood up in a wooden box, in such a position that the steering axis was approximately at the latitude angle. The box was then filled with Portland cement (1 part cement with 3 parts of clean sand and sufficient water) which was allowed to solidify. The larger places were filled with bricks and rock fragments to economize the cement. A day or two is sufficient for the solidification, after which the box can be knocked to pieces, leaving the frame rigidly mounted in a solid and very massive block. This block was placed on a small brick pier and the adjustment of the polar axis made by blocking up one end of the cement base. A short piece of 2×4 -inch joist was lashed to the handles of the bicycle with strong wire, which served as a support for the declination axis. The rest of the stand is to be designed according to the use to which it is to be put. In my own case I required merely a device which would enable me to keep my quartz telescope pointed accurately at the moon for two minutes. From odds and ends which had accumulated in my shop the arrangement shown in the illustration was built. A short plank was mounted on the 2×4 on a horizontal steel axis turning in brass bearings. To the forward end of the plank a rod was fastened which passed through a wooden block clamped between the lower ends of the front forks with a small bolt. This block could be turned to suit the elevation of the telescope, and the rod fastened with a "set-screw," shown by an arrow in the picture.

Slow motion about the polar axis was accomplished by a brass rod, hinged to a larger piece of rod which fitted into the T tube which formerly carried the saddle. A small piece of brass tubing was soldered to a small piece of $\frac{1}{4}$ -inch sheet brass, through which passed the slow-motion screw, sharpened to a point and turned by a small wooden wheel, made from a

spool (indicated by an arrow). The brass tube and screw could be clamped at any point on the long brass rod by means of a set-screw. The point of the slow-motion screw turned in a small conical pit in a piece of brass fastened to the end of the 2×4 joist. The weight of the instrument being carried on the handles, that is, above the polar axis, the instrument always tended to turn (by gravity) upside down, except when pointed at the meridian. This it was prevented from doing by the pressure of the point of the slow-motion screw; and by turning the screw either forward or backward according to whether the instrument was pointing east or west of the meridian, a very uniform rotation about the polar axis was secured. A diagram of the slow-motion screw is given in the accompanying line drawing.

The instrument was set approximately in the meridian by sighting the pole star in line with the edges of the two front tubes of the diamond frame. The proper elevation of the polar axis was secured by trial, observing whether, in following the moon, it moved up or down in the field of the telescope. In half an hour I got the thing in such shape that I could keep the center of a small crater on the point of intersection of the cross hairs of the telescope for ten minutes, and as this was more than the required accuracy I let it go at that. The instrument as constructed works admirably except when pointed at the meridian. On passing the meridian the slow-motion screw is carried over to the other end of the 2×4 joist, this movement being allowed by the hinge at the end of the rod. When accurate following is not necessary, that is, when it is merely necessary to keep the object in the field, a more convenient arrangement would be a brass cog wheel attached to the steering rod below the handles, and turned by a worm wheel: this would obviate the trouble when crossing the meridian. It would not, however, give such uniform motion as the arrangement described, unless accurately and carefully made.

For mounting a small telescope any device can be used which will permit the instrument to swing up and down in a plane.

It is quite remarkable how well the old bicycle frame lent itself to the construction of the stand. The front forks which hold the "elevation" fixed, and the saddle tube for supporting the slow-motion rod, could hardly be improved upon if made for the purpose.

ALTERNATING CURRENT EXPERIMENTS.

BY FREDERICK E. WARD.

Students and amateurs who like to make electrical experiments are particularly fortunate if they have alternating current lighting service in their homes, as the alternating current lends itself especially well to the performance of easy experiments that are at the same time both amusing and instructive. Of the many kinds of experiments that may be made with simple apparatus there are perhaps no others that are more interesting than those which illustrate the principles of the rotary magnetic field and its application to electric energy meters and to induction motors.

For making the necessary apparatus there are required two similar laminated iron rings about $3\frac{1}{2}$ inches inside diameter, $4\frac{1}{2}$ inches outside diameter, and $\frac{3}{4}$ inch thick. These may be built up by coiling up a sufficient length of thin sheet iron strips, cut $\frac{1}{4}$ inch wide, using a round wooden block to start on. Compact iron wire bundles of about the same dimensions may be substituted with good results, or, better than either of the above, rings made up of a sufficient number of thin sheet-iron punchings. After the rings are made, all sharp edges should be rounded off with a file and a smooth covering of cotton tape be applied as shown in Fig. 1, A.

If there is any choice between the two rings, select for the field the one that comes nearest to being a true circle on the inside. For the winding on this ring use No. 23 or No. 24 double cotton-covered magnet wire. Have the wire on a spool small enough to pass through the ring easily, and begin at any point such as B, Fig. 1. Wind the wire in a single layer, with turns as smooth and close as possible on the inner circumference, until exactly one-quarter of the latter has been covered. Next reverse the direction of winding as shown at C, Fig. 1, and cover the second quarter of the ring by passing the spool through in the opposite direction, after tying down the little loop at C with a piece of thread. Make similar reversals at the half and three-quarter points, and cut off the wire near the place of beginning. This completes one-half of the winding. The second half is to be wound on top of the first half, and is to be similar in all respects except that the place of beginning must be shifted to a point 45 deg. away, as at D, Fig. 1.

The second ring, which is for a reactance, is to be wound with 600 turns of magnet wire of any size larger than No. 20. This winding

must not have any reversals in it, all of the turns being passed through the ring in the same direction.

Lay the two rings down flat on a piece of board and make connections to a 110-volt 60-cycle supply circuit as shown in the diagram in Fig. 1, where S indicates a snap switch or knife switch, and L, L, L, L four 16-candle-power 110-volt lamps. When the switch is closed, current flows through the two windings on the field ring in such manner as to produce four magnetic poles that are not stationary but rotate

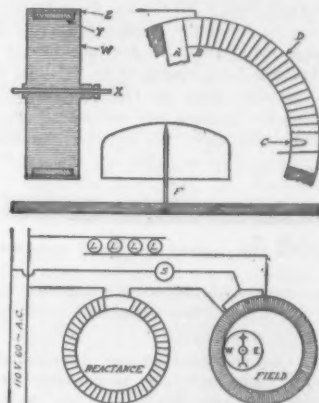


Fig. 1.—DETAILS OF THE EXPERIMENTAL APPARATUS.

or progress around the ring 1,800 times per minute. A pocket compass placed close to one side in the field as shown will rotate at this speed and illustrate the principle of the synchronous motor, in which the magnetized rotor is dragged around by the rotating magnetic poles of the field just as positively as if it were geared directly to the dynamo. If the compass be placed close to the ring on the outside, it will turn in the opposite direction. The field can be reversed by exchanging the connections to either one of its two coils.

To show the poles made by the field, lay a sheet of white paper on the ring and sprinkle some fine iron filings on it while the current is on. It is not so easy to show the movement of the poles in this way, but it may be done as follows: Shake some very fine iron filings through a piece of cloth on a sheet of paper, and then hold up the latter by one corner. The larger particles will slide off, and only the very finest will cling fast like dust. Lay the paper on the ring while the current is off, and close the switch for the briefest possible moment. Do this several times in succession, and considerable movement of the particles will be observed.

Drive a large pin through a piece of wood as shown in Fig. 1, F, and balance on the point a brass box cover or bell so that the latter is free to turn. If the magnetic field be then placed around the bell, the latter will be slowly dragged around by reason of the eddy currents set up therein, and will illustrate in part the principle of the driving mechanism of some forms of integrating wattmeters. Observe how the speed of the piece of brass varies in proportion to the number of lamps that are lighted at L.

If an iron (tin) box cover be substituted for the brass one the speed will be higher and the pull more vigorous, illustrating the principle of the induction motor. If an empty tin can be thus supported in the field, it will be rotated with considerable force and soon get off the pin. Fig. 2 shows how the field may be supported in a vertical position and provided with a better rotor, from which it is possible to get enough power to drive light toys. The details of the rotor are shown in Fig. 1, where W is a turned wooden support provided with a small shaft X, and having in its periphery an iron hoop Y over which is slipped a copper hoop Z. To be efficient the rotor must be made of a diameter as large as possible without touch-



EASILY CONSTRUCTED EQUATORIAL MOUNT FOR TELESCOPES.

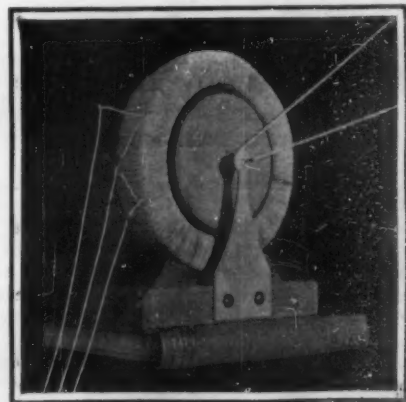


Fig. 2.—ALTERNATING CURRENT MOTOR.

ing the windings of the field. It should be made to run true, and turn easily on its shaft.

The performance of the above experiments and of others that will be suggested by them can be made more interesting by studying the reasons why from some good textbook on the elements of alternating currents, to which the reader is referred for a fuller explanation of the principles involved.

DEVICE FOR REMOVING WOOD SCREWS.

BY JAMES PATTERSON.

In the Handy Man's Workshop department of July 31st, a device for removing wood screws was described which struck me forcibly. Another device for the same purpose has been designed by William Laycock, a weaving section hand in the Arlington Mills of Lawrence, Mass. Quite often screws in the shuttle springs for holding down the spindle will break, and the difficulty formerly was to get out these screws with-



DEVICE FOR REMOVING WOOD SCREWS.

out injury to the shuttle, so Mr. Laycock bethought him of an old screw-driver spindle, cut the point off, and then with a hacksaw cut two grooves in it at right angles as indicated in the illustration. The grooves were made as wide as possible and fairly deep, leaving the edges sharp. In use the tool thus prepared is pressed against the broken piece of screw and digs into it sufficiently to permit of turning and thus removing the screw.

MENDING A BROKEN METALLIC FILAMENT.

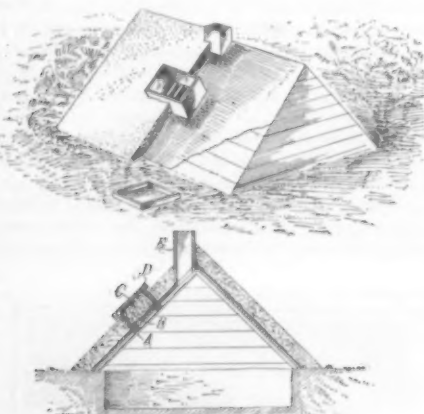
BY HOWARD W. NICHOLS.

A carbon filament incandescent lamp, when the filament breaks, is of no further value, but in the case of a tungsten or tantalum lamp it is often possible to mend the filament so that the lamp will be nearly as good as new. Place the lamp with the broken filament in a socket which is connected to the lighting circuit by a flexible lamp cord. Turn on the current and gently shake the lamp so that the broken ends of the filament will strike against the main part, and draw a small arc which will weld them securely to it and thus allow the current to pass through the filament, lighting it up brighter than before breaking. This mending process usually cuts out only a small section of filament; but if a comparatively large portion of the filament should happen to be cut out of the circuit, it would reduce the resistance of the remaining filament to such an extent that an excessive current would flow and thus soon burn the filament out. However, while it lasted, the lamp would give a very bright light.

A SIMPLE FRUIT CELLAR.

BY F. A. KAISER.

Doubtless many readers of the SCIENTIFIC AMERICAN have found it difficult to keep apples and the produce of their gardens, such as carrots, beets, turnips, celery, etc., in perfect condition until they could be used. The accompanying drawings show a cheap and easily made fruit cellar in which I kept twelve bushels of apples, besides carrots, squashes, and potatoes, from October until April. My house was six feet wide, eight feet long and six feet high, and cost me



A SIMPLE FRUIT CELLAR.

about \$4. Smaller ones can be built for a proportionally smaller sum.

I dug a hole about eighteen inches deep and set the house over it, as shown in the cross section. The entrance is made like a box, about twelve inches deep, so that soil or manure can be spread over the roof to a depth of about ten inches. Cleats A on the inside of the opening hold slats B at the bottom of the box opening. In the space C I stuff an old tick filled with straw or leaves. Outside cover D protects the tick from moisture. The rafters should be about two inches square, or 1x3. Provide a chimney, E (of

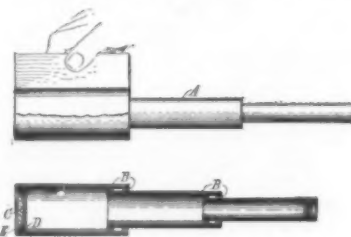
wood), which must be stuffed with straw during zero weather. The chimney is not absolutely necessary, as the house can be ventilated through the door during mild weather. The proper slant for the roof is about 45 deg., as earth can be packed on at that slope. Cover the roof with a cheap grade of building paper, or with newspaper, before putting on the earth, but do not use a paper that has a strong smell, like tar paper.

I have had this house in use now during three winters, and it has saved me more than its cost every year. Apples and vegetables keep fresh and plump in it, and do not shrivel up as they will in an inside cellar.

HOW TO MAKE A PAPER TELESCOPE BARREL.

BY C. R. McGAHEY.

The making of a paper telescope barrel is shown in the accompanying illustrations. First we make a wooden mandrel, A, that represents the various reductions in the barrel of the instrument. These portions of the mandrel are made of such diameters as to bring the interior of the barrel to the proper size. Wrap on a layer or so of paper having a dull black finish so as to keep down any reflection of the rays of light on the interior of the instrument. When several layers of this paper have been carefully applied, Manila paper such as used by draftsmen in making pencil drawings should be laid on over it. It is understood that this paper is laid with glue between each layer, and this can be done to best advantage with the wooden mandrel placed between lathe centers. When the paper has been wrapped on to a thickness of about 1/4 inch we shall have good substantial tubes. The exterior may be varnished or covered with cloth or paper of fancy pattern. The stop pieces are simply rings laid on as shown at B. When these stop rings have been placed in position the ring E is applied and glued fast, after which the lens is fitted against it and a second ring F is applied to hold it in place.



A PAPER TELESCOPE BARREL.

These rings must be of dull black finish. The eye-piece may be applied in the same way. This makes a most excellent case for a telescope.

RESTORING A DRY CELL.

BY DR. EDWARD M. HANSON.

Having experienced a great deal of trouble with the usual small cell batteries, such as are used for medical wall plates, gasoline engines, etc., I have experimented until I have discovered a very simple method of restoring the ordinary dry cell sal-ammoniac battery. My method is as follows: Midway between the carbon and zinc at the top of the battery drill a hole 3/16 inch in diameter down to within 1 1/2 inch of the bottom of the cell. On the opposite side drill a hole through the sealing wax covering 1/16 inch in diameter and 3 inches deep. Place a small glass funnel in the large hole with the stem at least 2 inches long. Into this pour one ounce C. P. hydrochloric acid. After this is thoroughly absorbed pour in the funnel one ounce of water. When all is absorbed, seal the holes with ordinary stationer's sealing wax. After twelve hours it will be found that the batteries so treated will work with increased voltage and amperage over a new dry cell. They will work well on either closed or open circuit and have from four to six times the life of a new dry cell. I am using a series now that I employed in my office for three years, and during that time have renewed them three times. The batteries will work until the zinc pole is completely exhausted if the chemical elements are kept at the required strength by renewal.

THE HANDY MAN'S SUB-CALIBER GUN.

BY AUGUST MENCKEN.

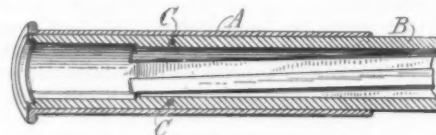
Those familiar with heavy artillery know that sub-caliber work forms a very important part of the drill. Very accurate work can be done by this method, but of course the range is very much shortened and the recoil and noise are missing.

Anyone having a large-bore rifle, such as the old model Springfield, and wishing to use it for short-range or gallery shooting, can sub-caliber it very easily in the following way:

Take an empty regulation shell and bore out the head so that its inside diameter will be the same throughout its length. Then take a 0.32 caliber 3-inch revolver barrel—the hexagonal kind used in cheap revolvers is good enough for this purpose—and turn it

up until it fits in the shell snugly but not so tightly as to swell the shell. Then carefully chamber the barrel to take the 0.32 cartridge. Great care must be taken in doing this, as the accuracy of the gun depends greatly on this part of the work. Next countersink the revolver barrel, B, so that the head of the 0.32 will lie flush with the head of the regulation shell A, as shown in the illustration. If this is not done the breech will not close and the shell may be accidentally exploded. Pins, C, should then be driven through the shell and barrel to keep the latter in place. This will not be needed if the barrel and inside of the shell are slightly tapered, the taper increasing from the muzzle end to the breech.

For ranges from 25 feet to 100 feet this method will



THE HANDY MAN'S SUB-CALIBER GUN.

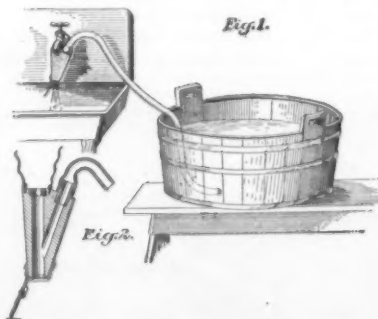
work very well, and if the rifle is built so that a longer barrel could be inserted, of course its range would be increased.

A DEVICE FOR EMPTYING A TUB.

BY C. W. FAIRBANK.

Considerable difficulty is often experienced in emptying and refilling the common form of movable wash-tubs. Stationary wash-tubs are usually provided with suitable plumbing connections whereby the water may be easily and quickly drained off, but with the ordinary form of wooden movable wash-tubs the entire tubful of water must either be lifted and carried to the sink or other drain to empty it, or the water must be bailed out of the tub and carried to the sink or drain by the pailful. The lifting of the tubful of water is often a physical impossibility, and the carrying of the water from the tub to the sink by the pailful is a tiresome task. If the house be provided with running water at the sink, a very simple contrivance may be devised for utilizing the city water pressure for the emptying of the tub. By providing a simple form of ejector at the faucet and connecting one inlet of the ejector to a short piece of hose leading to the sink, the water may be very easily drawn out of the tub into the sink, even though the latter be at a higher elevation. In the accompanying sketch, there is shown a simple contrivance of this character, in which the ejector is formed of a block of wood adapted to be detachably secured to the faucet. The ejector includes two passages intersecting at an angle and having a common outlet as shown in section in Fig. 2. One of these passages receives a stream of water under pressure from the faucet, and the escape of this water from the lower end of the ejector tends to draw water out of the tub through the hose and to deliver the latter to the sink.

The same device may be used for refilling the tub. To secure this object, it is merely necessary to close the lower end of the ejector with a plug or in any other suitable manner. As shown, a short rubber plug is connected to a strap tacked to one side of the block. By inserting the plug within the open lower end of the passage and securing the free end of the strap to a button on the opposite side of the block, as shown in dotted lines, the water will be caused to flow from the faucet down through one passage and



HANDY METHOD OF EMPTYING A TUB.

up through the other to the hose and thence to the washtub.

An interesting experiment to determine whether the strength of iron and steel was affected by magnetism was carried out at the Technical Institute of Belfast with the following reported result: Bars of mild steel and wrought iron 8 inches long by 1/2 inch to 1 inch in diameter were used, part of which were magnetized by being saturated in a solenoid. When tested, the elongation of the magnetized parts decreased 3 to 16 per cent, and the average breaking load seemed to be increased.

RECENTLY PATENTED INVENTIONS.

Electrical Devices.

ELECTRICAL FUSE.—A. G. FAY, Highland Park, Ill. The fuse is for use in blasting, the more particular purpose being to protect the materials and containing shells of the fuse against moisture. To this end the invention relates to the addition of an outer shell and a filling, the size of the diameter of the outer shell being slightly reduced at one end therefor for sharpening the effect of detonation of the fuse.

Of General Interest.

BOAT.—F. M. THOMPSON, East Liverpool, Ohio. Among the characteristic features of this patent is a vertically rocking rudder or tail-plate, the movement of which causes the prow of the boat to rise and fall in the water to a degree desired. To overcome any suction and break up formation of vacuum at the plate the latter is made hollow and means are provided to discharge air, into and through. Horizontal rudders or vertical axes are provided in front of the plate and in rear of the propellers for steering.

CRATE.—D. F. PAYNE, Corpus Christi, Texas. The invention relates to crates used for shipping, the more particular purpose being to provide a type of crate which may be folded readily when not in use, and provided with top and bottom members detachable from other portions of the crate and adapted to be sprung into position for the purpose of holding them into position.

WINDOW.—H. MORTENSON, New York, N. Y. This invention is an improved window, in which either the upper or lower sliding sash may be turned end for end and brought inward in the lower portion of the window frame, where the outside of the sash is easily accessible for washing or other purposes, and a ventilating space between the sashes provided if desired.

RECORD-HOLDER.—W. T. LONG, Sumner, Wash. The object here is to provide a holder arranged to accurately and securely hold the record in central position, to accommodate records of different sizes, to compensate for variations of the inside diameter of the records, to hold the record against accidental shifting in an axial direction and to allow placing it conveniently in position on the holder or removing it therefrom.

EMBRALING APPARATUS.—J. E. COPPOLA, Mexico, Mexico. An object in this invention is to provide a simple apparatus capable of holding the liquid and compressed air in a reservoir, and devices for connecting the same with trocars or needles for injecting the fluid under pressure into a cadaver.

FLASK FOR FORMING GATED MOLDS.—C. W. BLUE, Montgomery, Ala. This invention provides a construction of flasks wherein the gated molds may be formed in tiers, and the pattern members withdrawn therefrom; provides flasks wherein the cores may be inserted from the outside of the flask and held firmly in position; and provides a flask adapted to be mounted in tiers and arranged to accommodate molds of various sizes.

DRY SEPARATOR.—R. B. SNOWDEN, Houston, Texas. The invention relates to mills, and the object is to provide a separator more especially designed for treating crushed phosphate rock and other materials so that the material in a revolvable screen is subjected to alternate brushing and jarring actions, to thoroughly separate the valuable material from the extraneous matter.

SCREEN.—C. J. JEWETT, Fort Smith, Ark. The invention relates to screens which may be used for clay, coal, or other materials, and an object is to provide a screen with adjustable screen bars, and means to move the bars to predetermined distances from each other. Means prevent the material from becoming clogged between the screen bars.

DAMPER-REGULATOR.—R. P. MITCHELL and R. V. BRAWLEY, Statesville, N. C. A spring is adjusted to retain a disk against predetermined pressure in the boiler. Means permit the cylinder to exhaust, but should the pressure exceed predetermined value, means are provided to close or partially close the damper in accordance with the excess of pressure. A valve is so elevated that a disk closes the inlet opening to the pipe, but when pressure falls, means permit the cylinder to exhaust, the piston to move downwardly, to allow a weight to swing the damper into open position.

PARALLEL-RULER.—F. W. STERLING, Chicago, Ill. The invention appertains to drafting instruments, and its purpose is to provide a new and improved parallel ruler, more especially designed for the use of navigators and other persons, to permit them to accurately and quickly transfer parallel lines when translating courses on a chart.

CIGAR-PERFORATOR.—E. F. HALL, Fowler, Cal. The improvement is in that class of perforators which are provided with a series of opposite points or prickers pivoted and arranged convergently in such manner that when the tip of a cigar is pressed down between them they enter the same and thus form lateral holes which assist in producing an easy draft.

WINDOW-VENTILATOR.—G. W. STEIN, Chicago, Ill. The inventor provides a device in which good ventilation is secured, while at

the same time the ventilating opening is shaded without the necessity of using a projecting awning or other similar device. He provides a device which while permitting good ventilation prevents the rain or snow from entering while the device is in use.

Hardware.

WRENCH.—W. A. PRATT, Stamford, Conn. This wrench is adapted for screwing up or unscrewing caps or jars and other packages, and for loosening the caps from the rubber or other packing rings, it being adjusted for gripping objects of various sizes, and having handled V-shaped jaws pivotally connected with each other at their ends and a supplementary jaw adjustably and removably attached to one of the jaws to co-act with the opposite jaw.

WOODWORKER'S PLANE.—J. H. BROWN, Boston, Mass. The intention here is to provide for a plane that facilitates the exact adjustment of the cutter bit laterally and longitudinally in the throat of the plane stock, enable the quick and exact graduation for size of the throat opening in the stock, provide means for clamping the cutter bit when adjusted in the throat opening.

TUBE-CUTTER.—O. R. YOUNG, Riverhead, N. Y. The invention is useful for various different purposes, and particularly in facilitating the removal of defective tubes in a boiler or similar tubular structure. In a boiler access cannot easily be had to the exterior of the tube and some difficulty is experienced in removing the tube unless it be cut in two from the interior.

COMBINATION TOOL.—W. J. TWEEDALE, Saginaw, Mich. The intention in this case is to provide a wrench of ordinary construction, with attachments whereby it may be used as a pipe wrench or a drill, or a turning lathe, and for many other purposes. The handle may slip out of the extreme end of the shank so as to give room between the jaws for the drill bit.

Heating and Lighting.

CORE-OVEN.—J. J. JOHNSON, Newark, N. J. The invention relates particularly to core ovens used for drying or baking cores used in molding. The object is to produce an oven which will be simple in construction, the temperature of which can be nicely regulated, and which will have a construction which will enable the oven to be kept constantly filled.

ILLUMINATING SIGN.—J. F. DEUAR, Buffalo, N. Y. This invention relates to advertising signs such as those hung out in front of stores or shops to indicate the business done therein. An object is to provide an illuminated sign which can be read at night from a considerable distance with ease and which can be equally as well read in the daylight.

Machines and Mechanical Devices.

COMPUTING-PUMP.—S. G. WISE and J. E. TROYER, JR., Gas City, and J. E. SMISOR, Marion, Ind. The invention refers to computing pumps, and more particularly to pumps designed to be used in dispensing and selling fluids such as oil and the like. When one gallon of fluid is pumped by the pumping mechanism, one gallon is registered by the computing mechanism. When one gallon has been forced through the casing, the dial has made a complete revolution.

VENDING-MACHINE.—F. A. SLICHTER, Kansas City, Mo. The aim of the inventor is to provide a machine more especially designed for use in stores and other places, and arranged to allow convenient delivery of the merchandise in predetermined quantities, without danger of packing and obstructing the rapid flow of the merchandise, such as seeds of various kinds.

AIR-SHIP.—A. E. G. LURKE, San Francisco, Cal. An object here is to provide a ship having an aeroplane and a balloon or gas bag connected therewith, together with an improved steadying means. A further object is to provide a balloon composed of one or more separate gas bags inclosed within a shell or chamber having means for regulating temperature. The propellers may be caused to rotate horizontally or vertically.

FEED MECHANISM FOR BORING-MACHINES.—A. FREY, Schöffland, Switzerland. The inventor provides a mechanism capable of being quickly changed for use as a hand feed or an automatic feed, and arranged to permit convenient changing of the gearing so that the feed mechanism for feeding the boring tool may be run at any desired speed according to the nature of the rock to be bored.

Prime Movers and Their Accessories.

ROTARY ENGINE.—F. O. BIRLE, Wilkinsburg, Pa. In this case the inventor's desire is to produce an engine in which the various parts are designed to permit of exact adjustment for controlling the motive fluid to permit of utilizing the expansive force of the fluid to a greater or less degree, and has had in view the construction of an engine which will permit of the use of as many cylinders as desired.

Railways and Their Accessories.

SAFETY SWITCH-LOCK.—A. HADDOCK and A. SCHMITT, New York, N. Y. An object here is to provide a lock which can be used in connection with various switch systems and block signal systems without interfering with the operations thereof, and which serve to lock a switch either open or closed as set by the switchman, so that the switch cannot be accidentally displaced while a train is approaching the switch or passing over the same.

LOCOMOTIVE-HEADLIGHT.—I. L. WADE and W. L. SMITH, Roanoke, Va. In the present patent the invention is an improvement in that class of locomotive headlights which are pivoted and so connected with the front truck as to be turned with the latter in passing around curves. The headlight, yoke and arms may be readily detached when required.

SNOW PLOW.—C. A. BELLEUD, Fairdale, N. D. The object here is to produce a snow plow which will effectively operate to cut the snow from the railroad track and eject it at the side. In its general construction the plow comprises a pair of cutter wheels which are mounted at a forward point, and behind these cutter wheels an apron is provided which assists in throwing the snow rearwardly into a drum, from which it is discharged laterally, or at right angles to the track.

Pertaining to Recreation.

SOCKET POST FOR SUPPORTING CROQUET ARCHES.—H. B. COLLIER, Prairie Grove, Ark. The purpose of this inventor is to provide novel details of construction for a socket post, which adapt it in pairs for a secure embedment in the ground at suitable points in upright positions, and for the convenient insertion of the limbs of a croquet arch thereinto, and thus afford stable support to the arch in a vertical plane and permit the removal of the arch.

Pertaining to Vehicles.

AUTOMOBILE-PROTECTOR.—D. F. ARMSTRONG, Groton, Conn. The invention relates more particularly to protectors such as are adapted to be arranged on the steering posts of automobiles to protect the drivers. It can be easily secured to the steering column of an automobile, and fitted with either a transparent or a translucent shield to protect the driver.

WHEEL.—L. Y. LEÓN, San Juan, Porto Rico. The invention relates to wheels for general use, the more particular purpose being to provide a wheel suitable for a road vehicle, and having a considerable degree of resilience due to the type of springs employed within the wheel and to the manner in which they are mounted and kept in position.

NOTE.—Copies of any of these patents will be furnished by Munn & Co. for ten cents each. Please state the name of the patentee, title of the invention, and date of this paper.



Kindly write queries on separate sheets when writing about other matters, such as patents, subscriptions, books, etc. This will facilitate answering your questions. Be sure and give full name and address on every sheet. Full hints to correspondents were printed at the head of this column in the issue of March 13th or will be sent by mail on request.

(12127) A. C. Co. asks: We would like to get an approximate idea of the amount of coal burned by the average ocean-going vessel of 700 tons net registry, drawing from 9 to 15 feet, that is to say, the amount of coal per hour burned in producing a speed of from 10 to 15 knots. A. It is impossible for us to give a reply to your question equally accurate and general for all cases, for the reason that coal consumption per horse-power varies so much with the efficiency of both engines and boilers, and horse-power for a given speed varies so much with the lines of the boat. For instance, a 700-ton yacht with fine lines might be driven at a speed of 10 knots with half the horse-power required to give the same speed to a cargo boat of the same displacement; and, as the boiler and engines of the yacht might easily have 50 per cent higher efficiency (say 30 per cent efficiency as compared with 20 per cent) the yacht might make the same speed as the cargo boat with one-third of the latter's coal consumption. Again, every steamship has its maximum economical speed; and whereas a given quantity of coal may drive it a little greater distance at a lower speed, any attempt to drive it at a higher speed will cause an increase of coal consumption out of all proportion to the increase of speed gained. There might therefore be a great difference between coal consumption at 10 and at 15 knots, and a boat of which the former was the economical speed might be unable to achieve the latter with any reasonable coal consumption, if at all. Although you only ask for an approximate idea, we must therefore make this reservation to show you how widely an average figure may vary from that of your particular case. If you gave tonnage, economical speed, and horse-power, we could give a fairly close figure for average lines, but knowing neither lines nor horse-

power, the chances of wide disparity are multiplied. With the foregoing reservation, we may say that the average coal consumption of three nominal 10-knot boats of 700 tons displacement in actual service, within our knowledge, is 9 tons per day. The horse-power of these ranges from 400 to 600 and averages 500, which represents 1.5 pound of coal per hour per horse-power, which is good marine practice for any except the most efficient multiple-expansion engines. Only one of those boats has ever been, or could be, driven at 15 knots, and that was as an experiment, and necessitated a consumption of 3,750 pounds of coal an hour, or nearly five times the economical consumption.

(12128) N. V. V. says: Being a constant reader of the SCIENTIFIC AMERICAN, I take the liberty to ask you the following question: If it takes 10 tons of coal to run a locomotive 100 miles in 10 hours, how much coal would it take to run the same engine the same distance in 5 hours? I claim that, as based upon the mechanical rule, what you gain in speed you lose in power, it ought to be about the same amount. A. It is impossible to answer your question exactly without a great deal more detail as to the locomotive, the load hauled, etc., but speaking generally, the fuel consumption is likely to increase out of all proportion to the speed, if the latter is increased above the economical speed of the engine. Each engine has a certain maximum speed at which it can haul a given load economically; and whereas with a given quantity of coal it can haul the same load a greater distance at a lower speed, at a higher speed the coal consumption increases very much more rapidly than the speed. For instance, an engine burning 1,930 pounds of coal per hour at a speed of 40 miles per hour uses 3,400 pounds per hour in hauling the same train 60 miles per hour, nearly doubling the coal consumption for a 50 per cent increase of speed, and 3,920 pounds at 70 miles per hour. These are figures from an actual test, the coal consumption varying directly with the horse-power expended. In your case, however, 10 miles an hour is not likely to be the economical speed of the locomotive and it is probable that it could cover 100 miles in 5 hours with the same or very little more coal than it would take to cover the same distance in 10 hours.

NEW BOOKS, ETC.

ASTRONOMY OF THE BIBLE. An Elementary Commentary on the Astronomical References of the Holy Scripture. By E. Walter Maunder, F.R.A.S. New York: Mitchell Kennerly, 1909. 34 ill.

Mr. Maunder's attitude toward the celestial miracles of the Bible does not differ essentially from that of the average non-astronomical Christian. He frankly regards the Bible as an inspired utterance. Although he does not hesitate to present the scientific theories which have been advanced to account for such miracles as Joshua's Long Day, the Dial of Ahas, and the Star of Bethlehem, he is more prone to consider them as divine portents rather than as ordinary astronomical occurrences. He constantly reminds us that the Scriptures were not intended to teach us the physical sciences, for which reason, in his opinion, it is almost futile to offer scientific explanations of Biblical miracles. In the case of the Star of Bethlehem, for example, Mr. Maunder is inclined to accept the miracle; and although he presents the usual theories of a conjunction of planets, a comet, and a nova, to account for the apparition, he regards the Star of Bethlehem as a specially devised miracle for the guidance of the Magi.

STATISTICAL AND CHRONOLOGICAL HISTORY OF THE UNITED STATES NAVY, 1775-1907. By Robert Wilden Nesser, Fellow of Yale College. In two volumes. The Macmillan Company, 1909. Quarto; 650 pp. Price, \$12 net.

In spite of the many books that have been written on the history of the United States navy, it is the opinion of the author that the record is yet incomplete. Hence he has undertaken the task of historian upon a scale of research and completeness that leave nothing to be desired; going back as far as possible to the original authorities, and—a most important feature—giving these authorities in the text. The completed work will be divided into five parts. The first three parts, here offered, are complete in themselves, and contain data concerning every engagement, capture, expedition, or other achievement of the navy prior to January 1st, 1907. The remainder of the work may be considered as supplementary. This is a monumental work carried out with great fidelity.

NELSON AND OTHER NAVAL STUDIES. By James R. Thursfield, M.A. New York: E. P. Dutton & Co. 374 pp. Price, \$4.

Unlike so much of the literature of the life of Nelson, the present work was written by a civilian. The fact of his reviewing the life of a naval officer from the outside, as it were, gives a new point of view, and serves to bring into relief certain features which are apt to be overlooked by the professional naval writer. Although the battles of the Nile and Copenhagen receive adequate notice, the Battle of Trafalgar naturally takes the first place. Mr.

Thursfield's idea of the plan of attack at Trafalgar differs somewhat from those commonly accepted; but after reading what he has to say, the impression is deepened that at Trafalgar, as in many other fights of that day, the plan of battle as outlined before the fight was greatly modified to suit the exigencies of the hour. This work will possess a particular interest for American readers, because so large a portion is devoted to an appreciative survey of the achievements of John Paul Jones. Mr. Thursfield is the first English writer of prominence to remove the stigma which was attached to Jones's name by the calumnious writers of his day, and reveal him as the admirable character that he was. One of the most valuable chapters is that in which full justice is done to Admiral Duncan, the hero of Camperdown, whose exploits and general professional ability seem never to have received adequate recognition until late in his career.

SECOND APPENDIX TO THE SIXTH EDITION OF DANA'S SYSTEM OF MINERALOGY. By Edward S. Dana and William E. Ford. New York: John Wiley & Sons, 1909. 8vo.; 114 pp. Price, \$1.50.

During the ten years of mineralogical investigation which this appendix covers, a large amount of material has been published. An evidence of this is to be found in the two hundred new names which are given in the classified list in the introduction. About sixty of these new names on account of the completeness of their descriptions seem to have a warrant for their acceptance as new species. The other names are either of imperfectly described minerals or variety names of well-recognized species. The descriptions of the new species included in this book are given concisely but completely. It was found, however, impracticable to follow the plan adopted in the System and the First Appendix of recalculating all the angles and crystal constants of the new species. This has been done in a few cases, but in the majority of the descriptions the figures of the authors have been accepted without verification. In the cases of some of the new species with complex crystals it has been impossible to give the complete lists of the forms identified upon them. The method followed has been to give the more common and prominent forms and to indicate the number of those not listed.

THE MAKING OF SPECIES. By Douglas Dewar, B.A., and Frank Finn, B.A. New York: John Lane Company, 1909. 8vo.; 400 pp. Price, \$2.50, postage extra.

The authors' aim in writing this book has been twofold. In the first place, they have attempted to place before the general public in simple language a true statement of the present position of biological science, and in the second place they have endeavored to furnish the scientific men of the day with food for reflection. As the British nation seems to be slowly but surely losing, through its conservatism, the commercial supremacy it had the good fortune to gain during the last century, so is it losing, through the unwillingness of any of her scientific men to keep abreast of the times, that scientific supremacy which she gained in the middle of the last century by the labors of Charles Darwin and Alfred Russel Wallace. It is not among Englishmen but among Americans and Continentals that the world has to look for advanced scientific ideas. The authors fear that this book will come as a rude shock to many scientific men. What they attack is not Darwinism, but that which is erroneously called Neo-Darwinism. Neo-Darwinism is a pathological growth on Darwinism which, we fear, can be removed only by a surgical operation. The book is a beautifully printed one and will doubtless interest all naturalists.

THE ELEMENTARY PRINCIPLES OF INDUSTRIAL DRAWING. By George Jepsen. Oblong 12mo.; 28 pp.; 11 plates.

The aim of this little book is to present the subject of industrial drawing, so that a student after he has become familiar with its contents, will have mastered all the essential principles as applied to mechanical and architectural drawing. While the book presents all the principles of industrial drawing, it is not a graded course of lessons, although if desired an elementary or more advanced course can be compiled from its contents. The author is an instructor in descriptive geometry, machine drawing, and shop work in the Massachusetts Normal Art School, and was for many years master of the Evening Science School of the city of Boston. The book appears to be an excellent one.

HENDRICKS'S COMMERCIAL REGISTER OF THE UNITED STATES FOR BUYERS AND SELLERS. New York: Samuel E. Hendricks Company, 1909. Quarto; 1220 pp. Price, \$10.

This is the eighteenth annual edition of Hendricks's Commercial Register of the United States. It is a complete and reliable annual index of industries, containing over 350,000 names and addresses of buyers and 35,000 business classifications. Full lists are given of manufacturers and dealers in everything employed in the manufacture of material, machinery, and apparatus used in these vast industries, from the raw material to the manufactured article and from the producer to the consumer. It is indispensable as a work of

reference for the architect, engineer, contractor, manufacturer, jobber, retailer, exporter, purchasing agent, and for the railroad machine shop, foundry, mill, factory, mine, and plantation. We have occasion to use several copies of this book, and it answers a vast number of our inquiries for manufacturers. It is a book which we can thoroughly commend.

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FOUR INTERESTING LETTERS

PEARY

NEW YORK, June 19th, 1908.

Dear Sir:—In regard to the watches furnished me by the Waltham Watch Co. three years ago, the behavior of the meantime watches was particularly excellent.

Watches carried by men in charge of different parties on the sledge journeys over the sea ice ran for weeks without any considerable variation from each other. This feature was a very distinct comfort to me in making me feel sure of my observations when the drift of the ice had carried me far away from all dead reckonings.

Most of these watches are now on Eagle Island, Maine, where I am going the end of this week. I will endeavor to get them on to you as soon as possible Very sincerely,

(Signed) R. E. PEARY, U. S. N.

Mr. James W. Appleton.

WELLMAN

WASHINGTON, D. C., Nov. 27th, 1899.

AMERICAN WALTHAM WATCH CO., Waltham Mass.

Gentlemen:—The nine watches made by you, which were carried in the Wellman Polar Expedition, proved entirely satisfactory. Two of these were injured slightly by the Norwegian sailors in the early winter. The remaining seven were used by me in ascertaining time and also positions of latitude and longitude. Position of stars computed by the aid of these watches could be depended upon to the accuracy of a second. Positions of longitude ascertained by Julius Payer twenty-five years previously were verified.

Extreme cold affected the movements but slightly, and in no way injured them. After returning to Norway but slight discrepancies were found upon comparing with Greenwich time.

In my judgment these movements are thoroughly reliable for any use and in any climate, being thoroughly compensated. Yours truly,

(Signed) QUIROF HARLAN,
Physicist to Wellman Polar Expedition.

LEFFINGWELL

MR. E. A. MARSH, Waltham Watch Company.

Dear Sir:—About three years ago your Company loaned me four of your watches for use on the Anglo-American Polar Expedition. I received them from Robins, etc., here, and yesterday I returned three of them to the same people. . . . I wrote to you from the North last summer telling of the remarkable performances of these watches and my private Waltham, during a two months' sled trip over the ice. They were compared with each other and chronometer corrected by observation nearly every day for a year and rates assigned for the ice trip. Daily comparisons were made among the watches on the trip, also, and with the chronometer after our return. The field rates were found to be practically the same as those assigned from the rates during the several months previous to the field trip. If it were not that all three watches came out the same, I should say that the obscure field rates were accidentally close to the calculated rates. The performance of your watches is emphasized by the fact that Capt. Mikkelsen had a hand-made pocket chronometer made to order in London at a cost of \$250.00. On this trip this expensive time-piece varied so greatly from the mean of the other watches that it had to be disregarded after the first week. The rates of your watches were changed but a fraction of a second, while the Captain's watch increased 35 seconds in its daily rate.

I took the greatest care in getting the best possible performance from the watches. I wore two myself and insisted that others took good care of theirs. The watches were worn night and day next to the skin and every precaution taken to keep their temperature constant.

Thank you very much for your kindness to us in loaning the watches. Yours, etc.,

(Signed) E. DE K. LEFFINGWELL.

The Shackleton Relief Expedition

BRITISH ANTARCTIC EXPEDITION, 1907

S. Y. "Nimrod."

LYTTELTON, 27th March, 1909.

MESSRS. R. W. CAMERON & CO., Wellington.

Sir:—Herewith I forward to you, per Purser S. S. "Maori," the seven Waltham watches so generously loaned to my officers and self by your Company for our use in the Antarctic.

Two of them unfortunately have been damaged. One of them by an accident down a crevasse, and the other during a sledge journey.

My officers and I found the watches reliable under all conditions. After a time we gained so much confidence in their rates that we had no hesitation in trusting to them when taking observations which required time-readings to seconds.

On their behalf and my own I beg you will convey to your Company my thanks for the use of the watches. I am, Sir, Yours faithfully,

(Signed) FRED P. EVANS, Lieut. R. N. R.,
Officer Commanding.

The Quadrangle Club, CHICAGO, Dec. 8th, '08.

N. B.—In buying a Waltham Watch always ask your jeweler for one adjusted to temperature and position

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Lamp, incandescent gas, O. Wiederhold.....	936,501
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Lamp socket, cluster, R. H. Benjamin.....	936,512
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Vibrations in mutually perpendicular planes are combined by means of an apparatus based on the same principle (Fig. 3). The resultant curves are traced on smoked glass so arranged before a lantern that the curves can be immediately projected on a screen and explained and studied at leisure, with a thoroughness that is not possible with the evanescent projections of Lissajous's figures made in the usual way, by reflecting a pencil of light from mirrors attached to tuning forks.

Chassagny's apparatus for the study of refraction consists of a glass globe supported by fixing its horizontal neck in a copper sleeve. If the neck is regarded as one pole of the globe, the opposite pole is indicated by an interruption in a copper meridian, and the equator is graduated in intervals of five degrees. Water is poured into a funnel attached to the upper side of the neck until its surface

A SIMPLE METHOD OF TEACHING EXPERIMENTAL PHYSICS.

(Continued from page 293.)

taneously. The needle traces an undulating line which cuts the base line in a series of points whose distances from the zero point are proportional to 1, 4, 9, 25, etc., that is, to the squares of the times. In this way the laws of falling bodies can be verified to within 1 per cent. This is a much closer approximation than can be obtained with Atwood's or Morin's apparatus, with which the beginning and end of the fall cannot be determined very accurately.

In other experiments the drum is driven by a cord, passing over the pulley and a grooved wheel 6 inches in diameter, attached to a simple driving clock, such as is used to turn a spit. With this arrangement the gradual diminution of the amplitude of successive oscillations of the pendulum, and the more rapid diminution brought about by attaching to the pendulum a paddle dipping into water, can be studied. The isochronism of small oscillations can be shown by giving the drum a uniform velocity of rotation, by means of the driving clock or of a weight which is stopped after it has fallen a certain distance. Then the base line and the undulations having been traced as before, the wave length, or distance between consecutive intersections of the two lines, is found to be constant, no matter what the amplitude or height of the wave may be, provided that it is small.

Chassagny's apparatus for compound vibrations in the same plane (Fig. 2) comprises two wheels mounted on parallel shafts. The first wheel is turned by a crank and drives the other by means of a belt. The ends of a fine violin string are attached to pegs inserted in the faces of the wheels at unequal distances from their centers, and the middle part of the violin string, which is kept taut by a spring, passes round a pulley, which turns freely on a vertical rod, attached rigidly to the horizontal axle of the nave of a bicycle wheel mounted in bearings. When the crank is turned both wheels revolve, and the horizontal displacement of the pulley, at any instant, is equal to the algebraic sum of the horizontal displacements of the two pegs. The movement of the pulley is followed accurately by a writing point which is attached to the other end of the bicycle nave. This point presses against a strip of smoked paper wrapped round a drum, which is turned by the engagement of a toothed wheel on its shaft with an endless screw on the crankshaft. The amplitudes of the two vibrations whose combined effect is sought are varied by varying the distances of the pegs from the axes of the two wheels; the phases are varied by setting one wheel, at the start, more or less in advance of the other by means of pointers attached to the wheels and fixed graduated circles behind them; the periods are varied by employing wheels of diameters proportional to the periods desired. For example, two wheels of nearly equal diameters give a graphical record of the phenomena of "beats."

Vibrations in mutually perpendicular planes are combined by means of an apparatus based on the same principle (Fig. 3). The resultant curves are traced on smoked glass so arranged before a lantern that the curves can be immediately projected on a screen and explained and studied at leisure, with a thoroughness that is not possible with the evanescent projections of Lissajous's figures made in the usual way, by reflecting a pencil of light from mirrors attached to tuning forks.

Chassagny's apparatus for the study of refraction consists of a glass globe supported by fixing its horizontal neck in a copper sleeve. If the neck is regarded as one pole of the globe, the opposite pole is indicated by an interruption in a copper meridian, and the equator is graduated in intervals of five degrees. Water is poured into a funnel attached to the upper side of the neck until its surface

(Concluded on page 305.)

Home-Made Experimental Apparatus

In addition to the following articles, the Scientific American Supplement has published innumerable papers of immense practical value, of which over 17,000 are listed in a carefully prepared catalogue, which will be sent free of charge to any address. Copies of the Scientific American Supplement cost 10 cents each.

If there is any scientific, mechanical, or engineering subject on which special information is desired, some papers will be found in this catalogue, in which it is fully discussed by competent authority.

A few of the many valuable articles on the making of experimental apparatus at home are given in the following list:

ELECTRIC LIGHTING FOR AMATEURS. The article tells how a small and simple experimental installation can be set up at home. Scientific American Supplement 1551.

AN ELECTRIC CHIME AND HOW IT MAY BE CONSTRUCTED AT HOME. is described in Scientific American Supplement 1556.

THE CONSTRUCTION OF AN ELECTRIC THERMOSTAT is explained in Scientific American Supplement 1556.

HOW TO MAKE A 100-MILE WIRELESS TELEGRAPH OUTFIT is told by A. Frederick Collins in Scientific American Supplement 1555.

SIMPLE TRANSFORMER FOR AMATEUR'S USE is so plainly described in Scientific American Supplement 1573 that anyone can make it.

A 1/2-H.P. ALTERNATING CURRENT DYNAMO. Scientific American Supplement 1553.

THE CONSTRUCTION OF A SIMPLE PHOTOGRAPHIC AND MICRO-PHOTOGRAPHIC APPARATUS is simply explained in Scientific American Supplement 1574.

A SIMPLE CAMERA-SHUTTER MADE OUT OF A PASTEBOARD BOX, PINS, AND A RUBBER BAND is the subject of an article in Scientific American Supplement 1575.

HOW TO MAKE AN AEROPLANE OR GLIDING MACHINE is explained in Scientific American Supplement 1582, with working drawings.

EXPERIMENTS WITH A LAMP CHIMNEY. In this article it is shown how a lamp chimney may serve to indicate the pressure in the interior of a liquid; to explain the meaning of capillary elevation and depression; to serve as a hydraulic tourniquet, an aspirator, and intermittent siphon; to demonstrate the ascent of liquids in exhaustive tubes; to illustrate the phenomena of the bursting bladder and of the expansive force of gases. Scientific American Supplement 1583.

HOW A TANGENT GALVANOMETER CAN BE USED FOR MAKING ELECTRICAL MEASUREMENTS is described in Scientific American Supplement 1584.

THE CONSTRUCTION OF AN INDEPENDENT INTERRUPTER. Clear diagrams giving actual dimensions are published. Scientific American Supplement 1515.

AN EASILY MADE HIGH FREQUENCY APPARATUS WHICH CAN BE USED TO OBTAIN EITHER D'ARSONVAL OR OUDIN CURRENTS is described in Scientific American Supplement 1516. A plunge battery of six cells, a two-inch spark induction coil, a pair of Leyden jars, and an induction coil, and all the apparatus required, most of which can be made at home.

SIMPLE WIRELESS TELEGRAPH SYSTEMS are described in Scientific American Supplements 1553 and 1551.

THE LOCATION AND ERECTION OF A 100-MILE WIRELESS TELEGRAPH STATION is clearly explained, with the help of diagrams, in Scientific American Supplement 1522.

THE INSTALLATION AND ADJUSTMENT OF A 100-MILE WIRELESS TELEGRAPH OUTFIT, illustrated with diagrams, Scientific American Supplement 1523.

THE MAKING AND THE USING OF A WIRELESS TELEGRAPH TUNING DEVICE. Illustrated with diagrams, Scientific American Supplement 1524.

HOW TO MAKE A MAGIC LANTERN. Scientific American Supplement 1545.

THE CONSTRUCTION OF AN EDDY KITE. Scientific American Supplement 1555.

THE DEMAGNETIZATION OF A WATCH is thoroughly described in Scientific American Supplement 1551.

HOW A CALORIC OR HOT AIR ENGINE CAN BE MADE AT HOME is well explained, with the help of illustrations, in Scientific American Supplement 1573.

THE MAKING OF A RHEOSTAT is outlined in Scientific American Supplement 1594.

Good articles on **SMALL WATER MOTORS** are contained in Scientific American Supplements 1494, 1049, and 1406.

HOW AN ELECTRIC OVEN CAN BE MADE is explained in Scientific American Supplement 1472.

THE BUILDING OF A STORAGE BATTERY is described in Scientific American Supplement 1433.

A SEWING-MACHINE MOTOR OF SIMPLE DESIGN is described in Scientific American Supplement 1210.

A WHEATSTONE BRIDGE. Scientific American Supplement 1595.

Good articles on **INDUCTION COILS** are contained in Scientific American Supplements 1514, 1522, and 1527. Full details are given so that the coils can readily be made by anyone.

HOW TO MAKE A TELEPHONE is described in Scientific American Supplement 966.

A MODEL STEAM ENGINE is thoroughly described in Scientific American Supplement, 1527.

HOW TO MAKE A THERMOSTAT is explained in Scientific American Supplements 1551, 1553, and 1556.

ANEROID BAROMETERS. Scientific American Supplements 1550 and 1554.

A WATER BATH. Scientific American Supplement 1464.

A CHEAP LATHE UPON WHICH MUCH VALUABLE WORK CAN BE DONE forms the subject of an article contained in Scientific American Supplement 1563.

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attains the level of the break in the meridian. The laws of refraction and total reflection can then be studied by directing luminous pencils toward the center of the globe, in the equatorial plane, and viewing them with the eye placed in the same plane.

In his electroscope (Fig. 4) Chassagny has made use of the fact that platinized glass is sufficiently transparent to allow objects to be seen clearly through it and yet reflects bright images of objects nearer the eye. A vertical and rigid strip of copper and a flexible strip of aluminium foil are suspended from a copper rod and inclosed in a case of which two opposite sides are of glass and the rest of metal. The rod carries a charging disk at its upper end and is insulated by passing through a block of paraffin, which rests on the top of the case. One of the glass sides is platinized, and outside it is placed a graduated quadrant which is seen by reflection, while the deflected strip of aluminium is seen through the glass.

Chassagny's galvanometer (Fig. 5) is inclosed in a wooden case, which is attached to the wall. In a strong magnetic field, formed by placing the like poles of two horizontal horseshoe magnets almost in contact with each other, is suspended a coil of wire of electrolytic copper. The intensity of the field is further increased by a soft iron cylinder, supported independently inside the coil. A large mirror, attached to the coil, reflects the image of a lamp to a screen, where the movements of the spot of light can be followed by the whole class. The galvanometer is provided with three shunts.

In Chassagny's apparatus for the study of electromagnetic induction (Fig. 6), a coil of wire is attached, with its plane vertical, to one end of a lever which can turn round a horizontal axis, and is balanced by a counterpoise on the other end. A vertical horseshoe magnet, with its poles directed upward, is placed so that the coil can be brought between the poles, or raised above them, by turning the lever on its axis. The positive and negative currents produced by these movements are indicated by a galvanometer connected with the coil. An alternating current is produced by allowing the lever to oscillate freely. Other experiments in induction may be made by sending through the coil a current from a battery.

M. Chassagny has devised a number of other ingenious instruments, including a very practical rheostat, a eudiometer, a baroscope, etc.

THE LATEST SUBMARINES OF THE UNITED STATES NAVY.

(Continued from page 296.)

merged condition, certain valves in the interior of the boat are opened. This allows the water from the sea to run into great tanks built within the boat, and thus virtually sink her. These tanks are closely gaged, so that just the required amount of water is taken in. Under normal conditions, when the boat is at rest with the ballast tanks filled, she will have a few hundred pounds reserve buoyancy, which is represented by the top of her conning tower protruding above the water. If desired, this buoyancy may be entirely destroyed by admitting a small additional amount of water, equal in volume to the volume of that part of the conning tower above water. While in the submerged condition, all communication with the outside atmosphere is necessarily cut off. The crew, usually about fifteen men, then breathes the air contained in the body of the boat. The amount of air originally contained within the hull is sufficient to support life with comfort for at least twenty-four hours. But, in addition to the air thus contained, the boat carries a large supply of compressed air in steel flasks, which, if used for breathing purposes, would be sufficient for a number of days.

After having brought the boat to the submerged condition in the manner

(Continued on page 306.)



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On December 11th, 1909, the SCIENTIFIC AMERICAN will issue a number devoted entirely to this Middle West region, a number which will set forth broadly and lucidly not only the agricultural interests of that region, but also those larger engineering undertakings which are destined to transform the Middle West, in part at least, into a manufacturing territory.

With that object in view the Middle West Number will publish articles on the following subjects:

I. THE CHICAGO AND GULF WATERWAY.—An illustrated description of Chicago's drainage canal, an engineering work which stands without a parallel in the world.

II. CHICAGO AS A RAILROAD CENTER.—Very few Americans realize that Chicago is the greatest railroad center in the world, and that it may be likened to a great hub from which radiate the spokes of American transportation.

III. THE WONDERFUL GRAIN TRADE OF CHICAGO.—Chicago is an enormous wheat bin, into which much of the grain raised in the middle West is poured. The conveying and handling of that huge amount of grain has necessitated the erecting and constructing of ingenious machinery and elevators.

IV. SHIPPING ON THE GREAT LAKES.—Most of the iron ore that is now smelted in Pennsylvania is mined in the middle West. To transport it to the blast furnaces of the East at a cost which will enable American steel makers to compete with foreign steel makers, it has been necessary to devise a new kind of lake transportation. Ships of 10,000 and 12,000 tons burden have been constructed which convey ore at small cost through the Great Lakes, and which are without a counterpart anywhere in the world.

V. THE HANDLING AND SHIPMENT OF IRON ORE.—The above-mentioned fact that iron ore is mined in the middle West and smelted in the East has necessitated not only the construction of special freight-carrying steamers, but also the designing of special machinery for loading and unloading the ore from the steamers.

VI. FREIGHTING ON THE MISSISSIPPI.—The Mississippi is the great natural waterway of the middle West. It places the cities along its banks in direct water-communication with every port in the world. That is why freighting on the Mississippi is a more important industry than most of us may realize.

VII. THE STEEL INDUSTRY.—Although the steel industry is still centered in Pennsylvania, the scene of its activity is gradually shifting. One of the greatest steel plants in the world is that which has been built at Gary. It is safe to say that nowhere else in the world will be found a plant so remarkably equipped and so efficient.

VIII. THE FREIGHT SUBWAY SYSTEM OF CHICAGO.—Chicago can boast of a rational system of handling freight by means of subways. Freight is carried from the railway car directly to the warehouse by means of tunnels aggregating sixty miles in length.

IX. THE WATER SUPPLY OF CHICAGO.—Chicago's source of water is Lake Michigan. The city is supplied with water by means of a tunnel which extends two miles out into the lake.

X. RECLAIMING ARID LANDS.—The United States Government has under way many irrigation projects for the purpose of reclaiming lands which are arid, but which will blossom if properly watered.

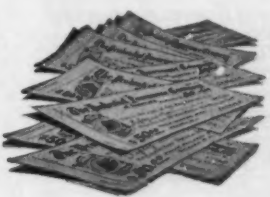
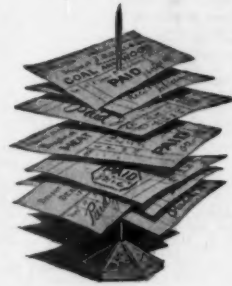
XI. HARVESTING THE GRAIN OF THE MIDDLE WEST.—Farms that cover not acres but square miles, crops that aggregate not simply bushels, but car-loads, have rendered it necessary to plant and harvest on an unprecedented scale in the middle West. The ingenious agricultural machinery which has been designed to cope with these peculiar conditions is described and illustrated.

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Spring, E. H. Wood	936,971
Spring link, A. B. Day	936,865
Square, bevel, D. E. Brandt	937,020
Stacker, hay, L. J. Lindsay	936,829
Stamp affixing machine, Hotchkiss	936,690
Stapling machine, E. T. Greenfield	936,931

above described, powerful electric motors are started by throwing in a switch. These motors derive their energy from storage batteries contained in the boat, and drive the propellers. The same storage batteries furnish current for numerous auxiliary motors used for pumping, steering, handling torpedoes, etc.

The motion of the boat when under way is controlled by two sets of rudders; one of these sets, known as the vertical rudders, directs the boat's course to port or starboard just as does the rudder of an ordinary ship. In addition, there are provided horizontal rudders, which serve to control the motion of the boat in a horizontal plane; that is to say, the depth at which she runs is regulated by these rudders. For steering in the horizontal plane, instruments are provided, so that the boat may be navigated with the same degree of accuracy as boats on the surface. The first of these instruments is known as a periscope. This consists of a vertical tube which extends from above the surface of the water to a few feet within the submarine. At the top of the tube is an object glass; at the bottom an eye-piece. Two reflecting mirrors, one at the top, the other at the bottom of the vertical tube, cause the image to be transferred from the object glass to the eye-piece. The operator can turn the periscope so as to sweep the whole horizon. To the writer, who recently made a five-hour trip in one of our latest boats, the view was as clear as though he were at the surface looking through an ordinary field glass. Hence when running submerged with the top of the periscope just out of the water, the navigator can see with perfect ease surrounding objects. If for any reason it should be desired to run at a still greater depth, compasses are provided by which the course may be steered with accuracy. For steering, submerged, in the vertical plane, instruments are provided which in a way take the place of the compass. One of these is a large pressure gage, which indicates the depth at which the boat is running. Another is a form of spirit level, which indicates the inclination of her axis. By the use of this, the man controlling the horizontal rudder is able to run at a perfectly even depth. While in the submerged condition, the boat is of course amply illuminated by electric lights. There are no ports or windows in the boat, and so far as sensations are concerned, one is unable to determine whether he is running on the surface or submerged.

The arm of the submarine is the automobile torpedo. A number of these may be carried. They are discharged through torpedo tubes located in the bow of the boat. Any modern type of automobile torpedo may be used. In view of the fact that the submarine is enabled to approach unseen to within a few yards, if desired, of the most powerful battleship, a long-range torpedo is not required. For this reason the weight devoted to motive power in the ordinary torpedo may be largely used to increase the destructive power, so that the proper arm for the submarine would be far more powerful and destructive than the ordinary automobile torpedo.

While the project of the submarine is comparatively old, it has so happened that but few of them have been used in real war. The first case on record is that of a little hand-power submarine boat built by David Bushnell in 1776. Having obtained permission from the American general in command to use this submarine against the English fleet anchored north of Staten Island, he instructed a sergeant named Ezra Lee in its use. After several attempts, Lee made an attack on one of the ships. His purpose was to fix a torpedo to her side, then go away and allow it to explode, thus destroying the ship. Unfortunately, the ship was sheathed with copper, and he was unable to attach his mine. Lee then drifted away from the ship, having abandoned his mine, which, after drifting about for an hour, exploded, throwing

(Concluded on page 307.)

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